The
REFINER
AND NATURAL GASOLINE
MANUFACTURER

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New Vapor-Saving Devices for Class IV Tank Cars

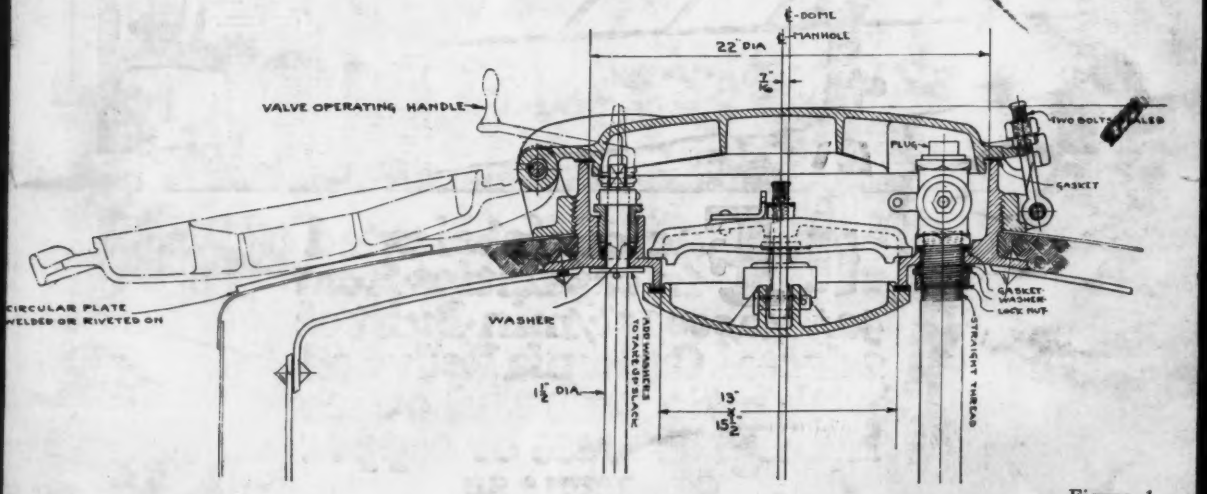


Figure 1

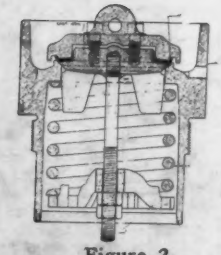


Figure 2

Figure 1 shows a new dome cover arrangement for Class IV Tank Cars which introduces a strong, gas-tight, pressure locking outer cover, a new internal hinged cover with two peep-sight holes, a new step gauge, a device for sampling contents without removing covers and means of loading and unloading without waste of gases.

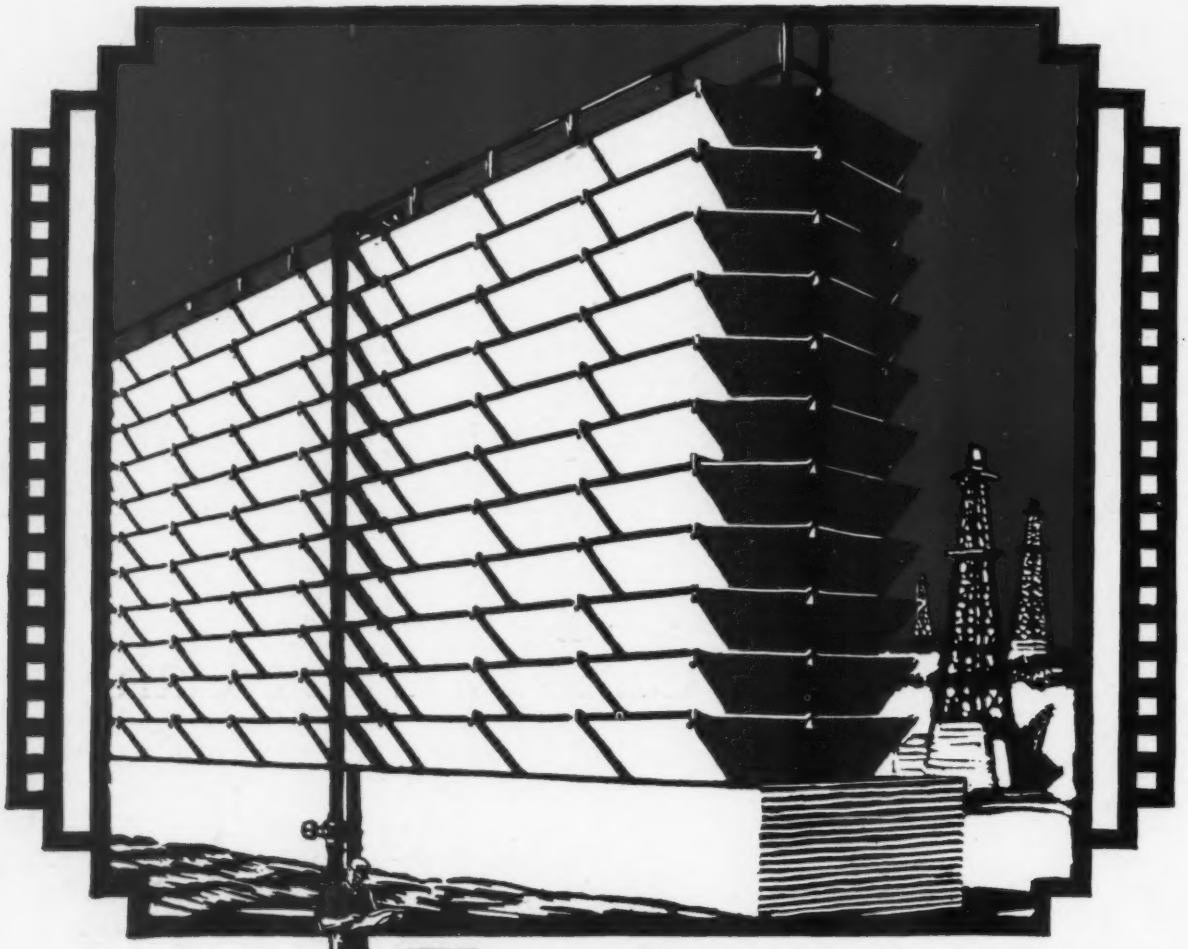
Figure 2 shows a new patented Safety Valve with resilient gasket, recently approved by the A. R. A., which prevents escape of gases under 25 pounds pressure.

Cars are now being built by us with these devices.

Complete information on request.

American Car and Foundry Company

Chicago	New York	St. Louis
Railway Exchange Building	30 Church Street	915 Olive Street



Factory fabricated in capacities from 50 to 150,000 gal./min. Built of selected California Redwood with bolts, rods and other fittings of brass or copper

C·F·BRAUN & CO
Manufacturing Mechanical Engineers
ALHAMBRA·CALIFORNIA
NEW YORK·DALLAS·TULSA
U·S·A

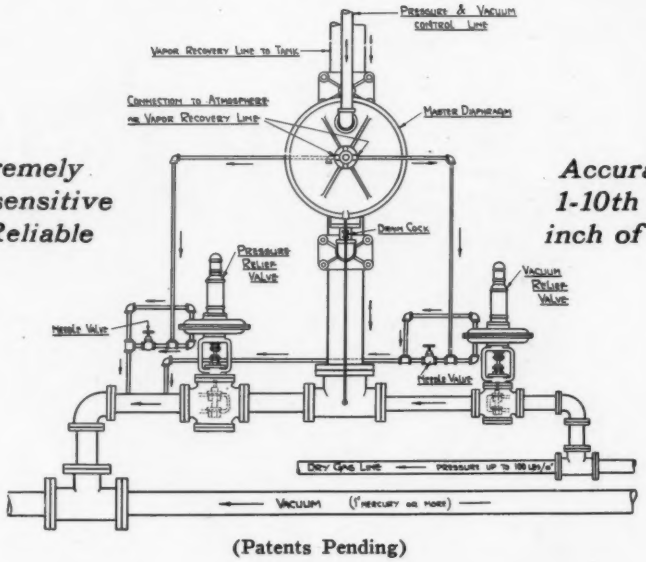
BRAUN

Atmospheric Cooling Towers

Entered as second class matter June 16th, 1923, at the Postoffice at Houston, Texas, under the Act of March 3, 1879.

All Tank Vapors Now Can Be Completely Recovered With the

Extremely Supersensitive and Reliable


Pressure & Vacuum control Line
Vapor Recovery Line to Tank
Connection to Atmosphere or Vapor Recovery Line
Master Diaphragm
Drain Cock
Pressure Relief Valve
Vacuum Relief Valve
Needle Valve
Needle Valve
Dry Gas Line — Pressure up to 100 lbs/o"
Vacuum (1" mercury or more)

Accurate to 1-10th of an inch of water

(Patents Pending)

NEILAN VAPOR RECOVERY REGULATOR SYSTEM

The Neilan Vapor Recovery Regulator System consists of a pressure relief valve and a vacuum relief valve, both operated from pilot valves connected to a master diaphragm. It will maintain atmospheric pressure in tanks and will not vary more than 1/10th of an inch of water; regardless of pumping in, pumping out, or expansion and contraction due to temperature changes.

The pressure relief valve will permit vapors to pass into the vacuum line at atmospheric pressure. The valve opens on the slightest increase in pressure above atmosphere, and will be fully open at 1/10th of an inch water pressure.

When pumping out of tanks the vacuum relief valve opens at the slightest vacuum and allows natural gas to pass into the tank.

The system is very simple and reliable. Once placed in operation, there are no further adjustments to make and it will operate several years without repairs. The materials used resist corrosion from hydrogen sulphide gas and other sulphur compounds. The valves will not chatter. No reducing regulator is required on the line to vacuum relief valve, for pressures up to 100 pounds. Descriptive circular on request.

NEILAN, SCHUMACHER & CO.

641-651 Santa Fe Avenue, Los Angeles, California

Branch: 307 East Fourth St., Tulsa, Okla.
P. H. Wilkinson, Manager

Representatives:

Maintenance Engineering Corp., 2000 Harrington Street, Houston, Texas

NEILAN

Pelican Well Tool & Supply Co., Shreveport, La.

"You Can Be Sure of Neilan Products"

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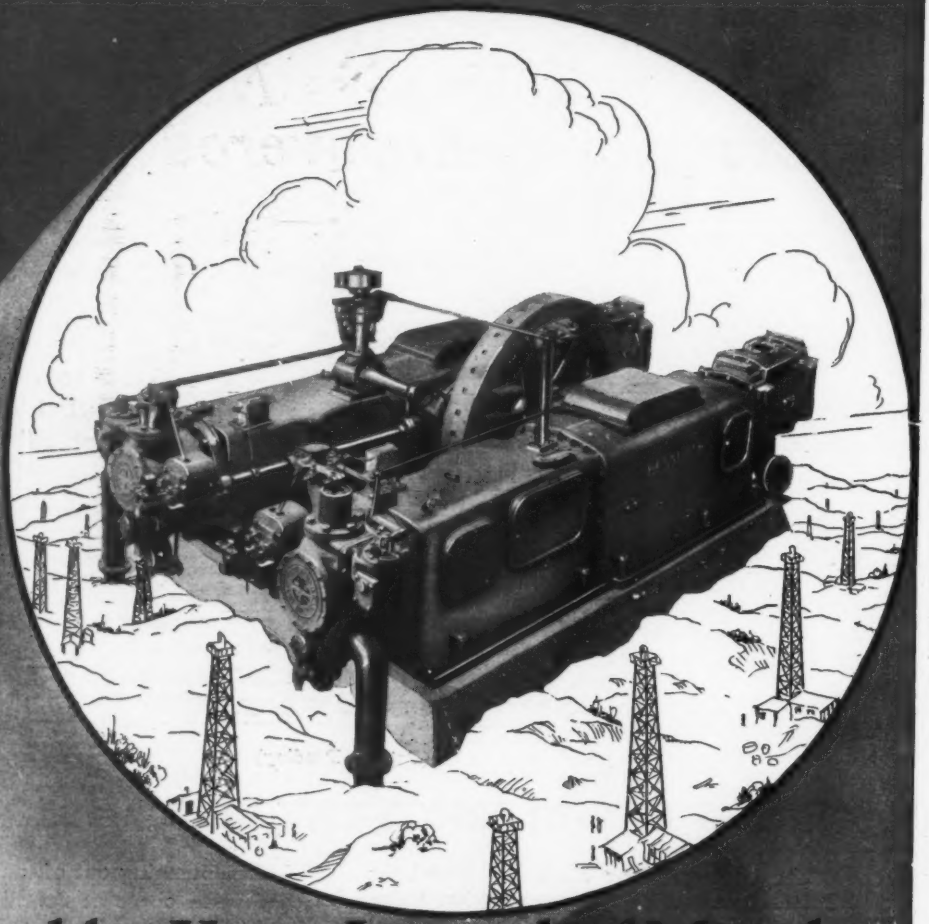


Measured by Years Instead of Months

THE true cost of gas compression can be arrived at only by a computation based on *years* of service. With Bessemer compressors this cost becomes materially lower as their length of service increases. Even figured over a period of weeks or months, Bessemers show an outstanding economy due to their high mechanical and compressor efficiency, low operating cost and fractional percentage of unproductive time.

As their length of service increases their economy is even more marked, due to their lower depreciation in service, and continued high average running time with practically negligible maintenance.

For any compressor service, Bessemer compressors—two cycle or four cycle—will show a decidedly lower cost per volume handled, and the longer the time the greater their economy.

THE BESSEMER GAS ENGINE COMPANY
18 York Street ∴ ∴ ∴ Grove City, Pa.

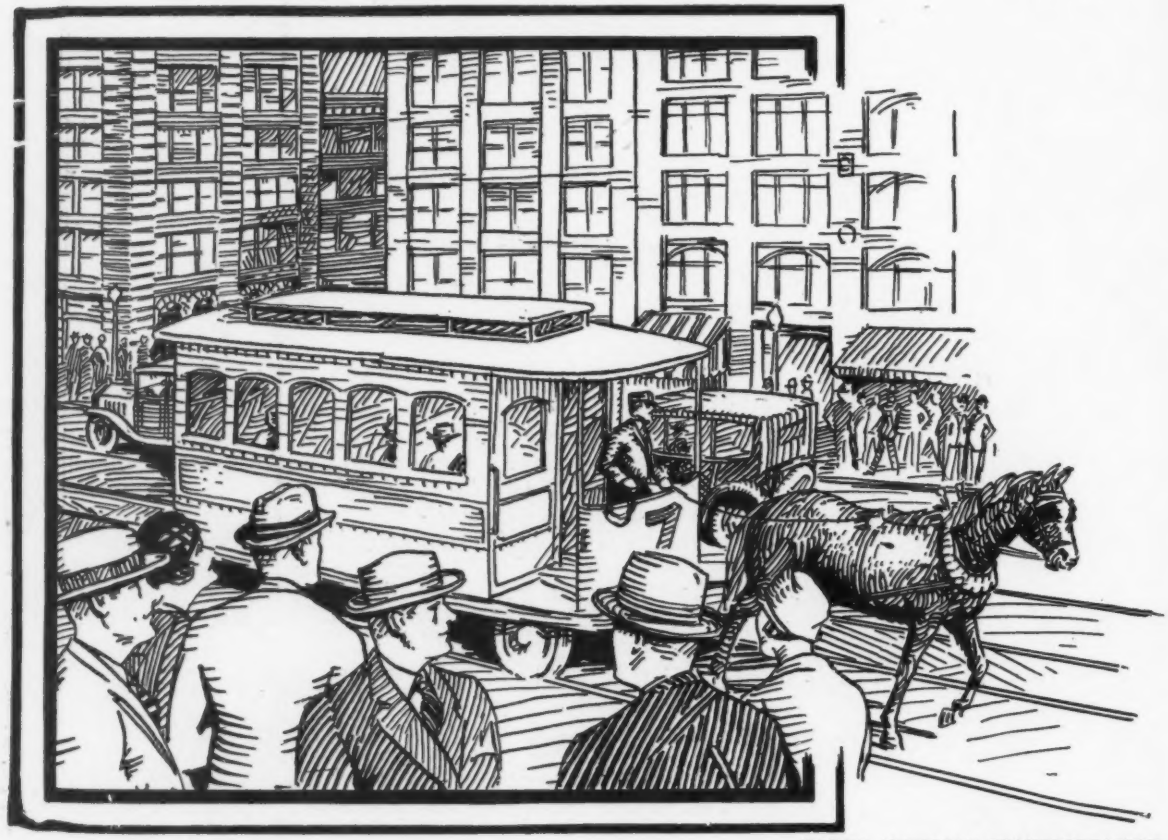
BESSEMER

SSEMER OIL FIELD ENGINES – COMPRESSORS VACUUM PUMPS – ROLLER PUMPING POWER

The views of Senator Wm. E. Borah relating to Oil Conservation, as expressed in his speech at Denver, June 28, 1927:

"If the waste and exhaustion of our natural wealth simply interrupted the gathering of wealth by the few immediately engaged, that would be unfortunate enough, but it embarrasses and impoverishes a whole people and puts the people and the government alike in jeopardy. The problem is in every sense of national import and of the utmost public concern."

Universal Oil Products Company
Owner of the Dubbs Process
310 South Michigan Ave
Chicago, Illinois



NORTH AMERICAN TRANSPORTATION
In New York City, up to a few years ago, a horse-car made a regular run each day.

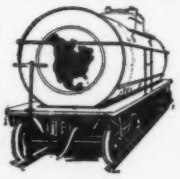
A Bit of Yesterday in the Busy Whirl of Today

One of the strangest sights in New York City, up to a few years ago, was the old horse-car which, to live up to the terms of a franchise, made its regular run each day.

Comparing this laborious vehicle with the big, high-speed, electric car of today, the visitor was struck with the marvelous developments that have taken place, almost unnoticed, in our everyday life.

One of the phases of this development in the commercial world is the policy of concentrating certain activities among companies specially fitted to handle them. To cite a few examples—the air mail is transported, not by the government, but by private corporations under contract with the government; sleeping cars are operated, not by the railroads, but by a private corporation; even automobile tires are leased by the manufacturer to certain large cab companies on a definite cost-per-mile basis.

In freight transportation this policy expresses itself in *car leasing.* The responsible lessor is fitted by organization, equipment and experience to operate, maintain and repair special freight car equipment. Because of the resultant economies, the shipper receives the benefit of car ownership at minimum cost. He gets precisely the type of car he needs, contracts for it only for the period the need exists, pays a definite rate for the service, and is relieved of all expense when the movement ceases.



If your product is shipped in tank, refrigerator or Palace poultry cars, you owe it to yourself and your company to investigate North American Leasing Service.

NORTH AMERICAN CAR CORPORATION, Executive Offices, Chicago, Ill.

Car Shops: Chicago, Ill., Coffeyville, Kans., Tulsa, Okla., North Judson (Ind.) Bulk Oil Warehouses, Chicago, Ill., Tulsa, Okla.
Export Terminal: New Orleans, La., Galveston, Texas

North American
CAR LEASING SERVICE

Mention Where You Saw the Advertisement

Another FLUOR ACHIEVEMENT!

(*Patented*)

The FLUOR Adjustable Drift Eliminator *and* Intermediate Deck

The greatest improvement in cooling towers since the advent of factory fabricated towers. An internal type of drift eliminator which not only permits control of windage loss but also greatly increases cooling capacity.

Outstanding Features:

No climbing necessary.

No bolts to change

No heavy parts to move

No hinges to rust or corrode.

No joints to keep tight.

No appreciable time or labor involved.

Direct Advantages:

Greatly increased effective cooling surface.
Decided up-circulation of air. (Improves performance.)
Reduced size of complete tower.
Reduced pumping head (Saves power.)
Reduced foundation expense.
Reduced first cost per gallon of water.
Reduced windage loss with resultant saving in make-up.
Prevention of water spray. (Permits placing tower closer to plant with consequent saving in pumping, pipe and ditching.)

Write at once for Bulletin No. 2-A

JACKSON ENGINEERING & EQUIPMENT CO.

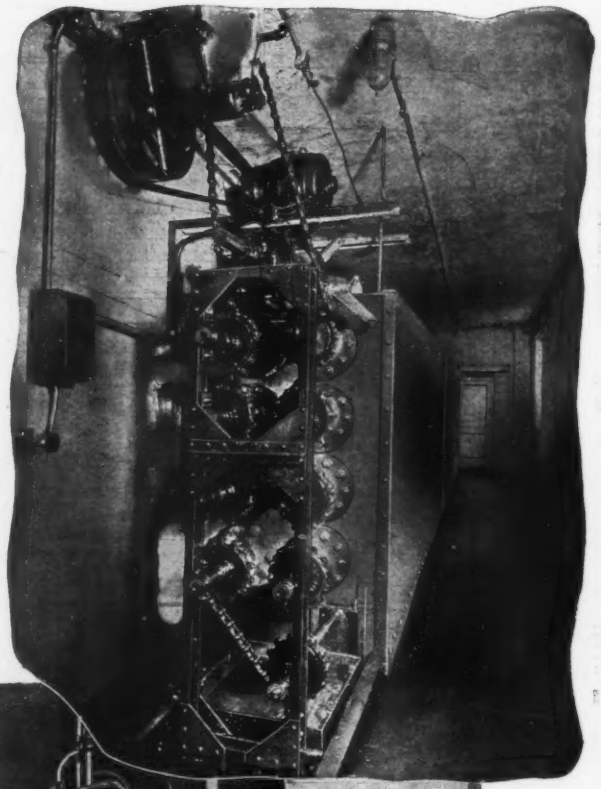
909 East 59th St.,
Los Angeles, Calif.

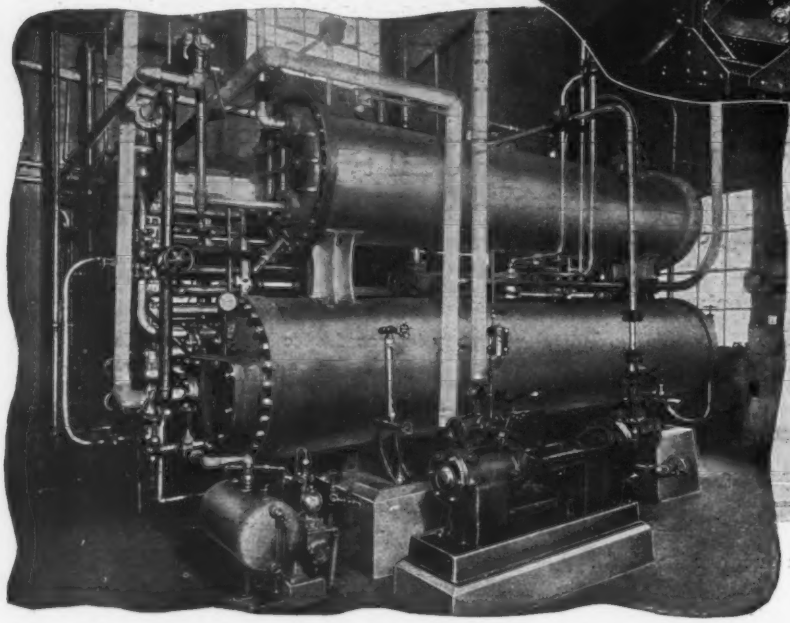
502 National Bank of Commerce Bldg.
Tulsa, Okla.

The Vogt WAX DISTILLATE CHILLING UNIT~

IN the treatment of distillate for separation of lubricating oils from by-products, low temperatures must be rigidly maintained. The Vogt exhaust steam refrigerating machine and Vogt standard chillers is the combination which, through years of service, has proved most satisfactory for this purpose.

Write for Details





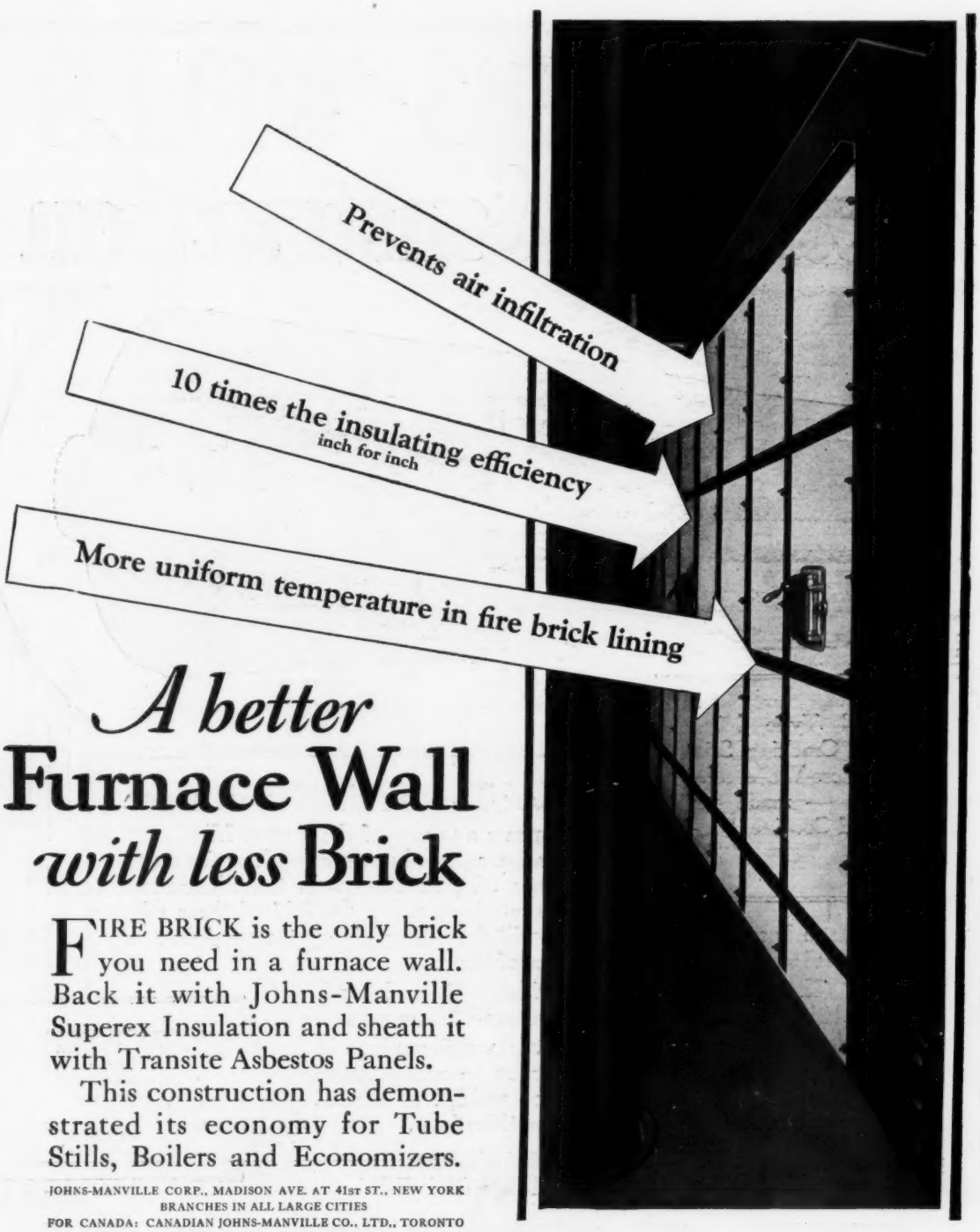
VOGT DOUBLE PIPE CHILLING MACHINE INSULATED

A COMPACT ABSORPTION REFRIGERATING MACHINE FOR CHILLING THE WAX DISTILLATE

Branch Offices:
Cleveland Philadelphia
Dallas New York
Chicago

HENRY VOGT MACHINE CO.
INCORPORATED
LOUISVILLE, KY.

Manufacturers of: OIL REFINERY EQUIPMENT, DROP FORGED STEEL VALVES AND FITTINGS, WATER TUBE AND HORIZONTAL RETURN TUBULAR BOILERS, ICE MAKING AND REFRIGERATING MACHINERY.


Prevents air infiltration
10 times the insulating efficiency
inch for inch
More uniform temperature in fire brick lining

A better
Furnace Wall
***with less* Brick**

FIRE BRICK is the only brick you need in a furnace wall. Back it with Johns-Manville Superex Insulation and sheath it with Transite Asbestos Panels.

This construction has demonstrated its economy for Tube Stills, Boilers and Economizers.

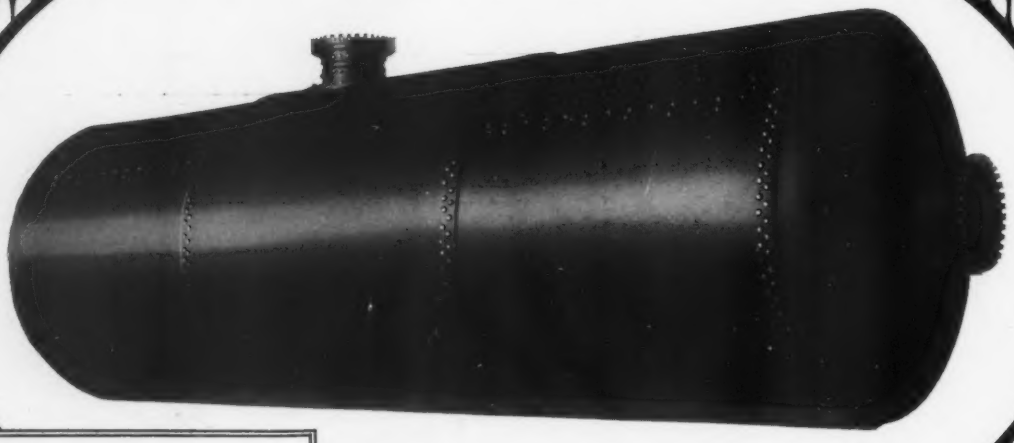
JOHNS-MANVILLE CORP., MADISON AVE. AT 41st ST., NEW YORK
BRANCHES IN ALL LARGE CITIES
FOR CANADA: CANADIAN JOHNS-MANVILLE CO., LTD., TORONTO

JOHNS-MANVILLE

Oil Industry Department

Asbestos
INSULATION
BRAKE LININGS
ROOFINGS
PACKINGS
CEMENTS

STRUTHERS-WELLS Steel Plate Construction



Special Type High Pressure Cracking Still of Struthers-Wells construction — made for large Mid-Continent refiner.

257 of These Stills Now in Use

Six years ago one of the largest Mid-Continent refiners placed an order with us for a special type still, as shown in the illustration. Since that time, orders for 257 of these stills have been received and you will find them giving the very best of service in all the large refineries of this company.

That surely is significant evidence of the dependability and satisfaction of Struthers-Wells products.

Operating the largest electric welding plant in the country it is possible for us to manufacture pressure and vacuum stills of welded or riveted construction. Send us your specifications.

FOUNDERS—MACHINISTS
BUILDERS OF SPECIAL MACHINERY

STRUTHERS-WELLS PRODUCTS FOR REFINERIES

Bubble Towers
Heat Exchangers
Dephlegmators
Condensers
Distillate Separators
Grease Mixing Kettles

STRUTHERS-WELLS CO

WARREN, PENNA.

MANUFACTURERS ENGINEERS

Steel Plate Construction

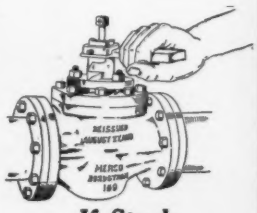
CHEMICAL REFINING RUBBER

Branch offices in principal cities

Seventy-Five Years of Accumulated Experience at your Service.

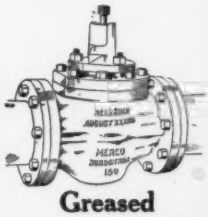
"Anything in Plate construction of Stainless Steel."

No Trouble from Sticking



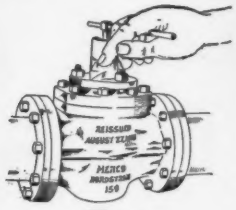
If Stuck

If, after long disuse the valve seems stuck, it requires no drastic wrenching.



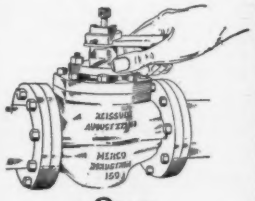
Greased

A stick of special Merco lubricant is inserted.



Turn Lubricating Screw

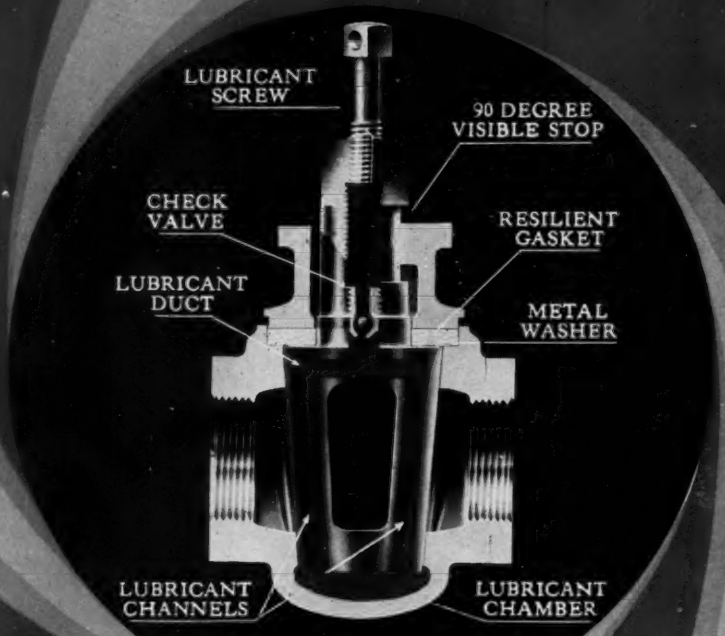
Hydraulic pressure of up to 2000 pounds per square inch is exerted upon the plug, by merely turning the screw.



Open

The Valve can then be easily opened or closed, without exertion.

Merco Nordstrom PLUG VALVES *Won't leak* AND *Won't stick*



It is unnecessary to open and close these Valves frequently to prevent sticking. The lubricant covers the entire surface of the plug and a slight turn of the lubricant screw adds hydraulic pressure whenever desired. Eminently satisfactory for service in Refineries—for different pressures and temperatures.

Just off the press—a special pamphlet written for Refining Engineers. Ask for a copy.

MERCO NORDSTROM VALVE CO.

SUBSIDIARY OF THE MERRILL COMPANY

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Chicago, Peoples Gas Building
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MERCO

Manufacturers

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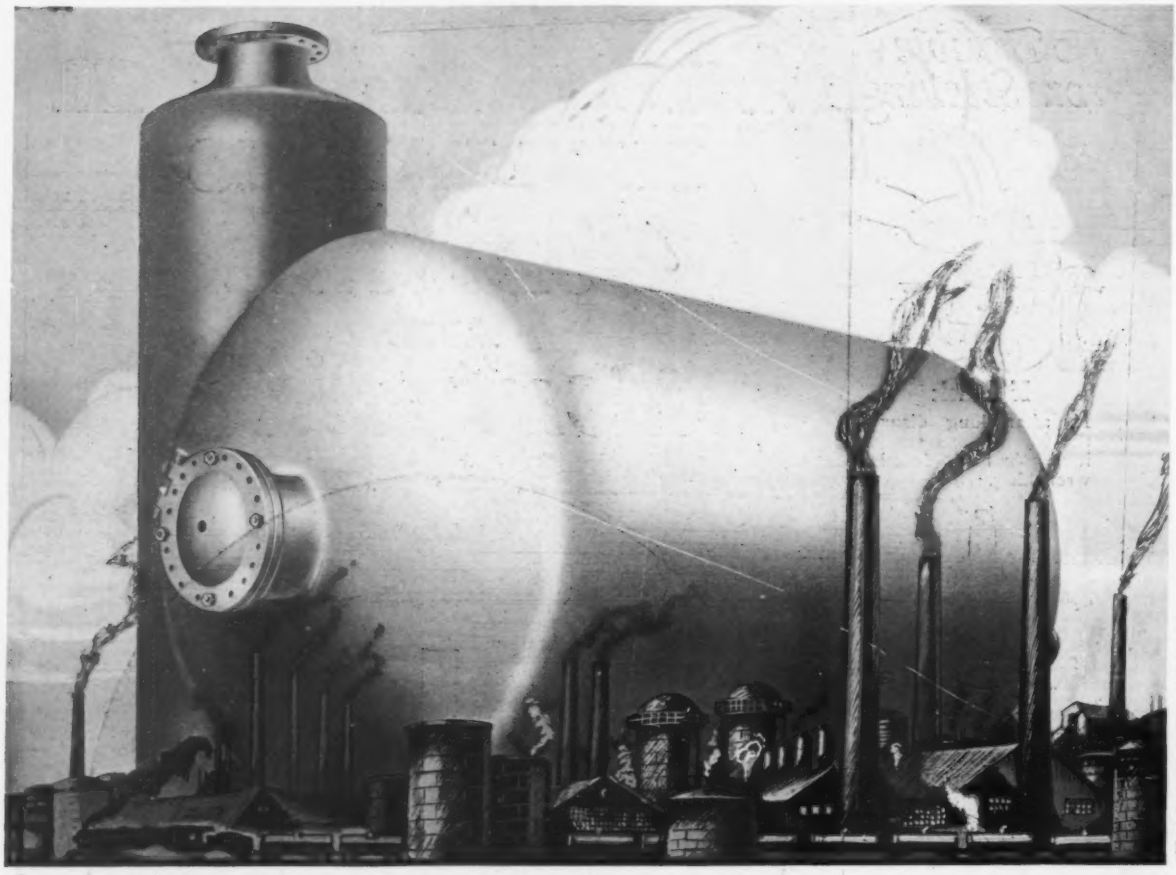
New Orleans, 1501 Masonic Temple Bldg.
Eastern Factory: Belleville, New Jersey

AGENCIES IN PRINCIPAL CITIES



Safety comes First

Specify Hammer-Weld for high pressure vessels

For the construction of high pressure vessels, such as dephlegmators, stills, expansion chambers, etc., hammer-welded shells offer the important advantage of maximum safety in addition to meeting all other requirements, as a hammer-forged weld is the strongest weld that can be made.

Manways, nozzles, etc., can be hammer-welded to the vessel; lugs and tapped holes can be furnished as desired, so that little or no shop work is needed at the point of erection. In addition, the vessels are free from internal obstructions, which makes them easier to clean; and the absence of seams or rivets means that danger from leakage of explosive or inflammable elements is minimized.

Whether planning for a single unit or a battery, it is well to remember that safety always comes first. Our Hammer-weld Fabricating Department is prepared to manufacture these vessels to a wide range of specifications. Cooperation and complete information will be gladly given to those interested.

Ask for Bulletin No. 13, describing high pressure vessels and stills for general purposes.

NATIONAL TUBE COMPANY

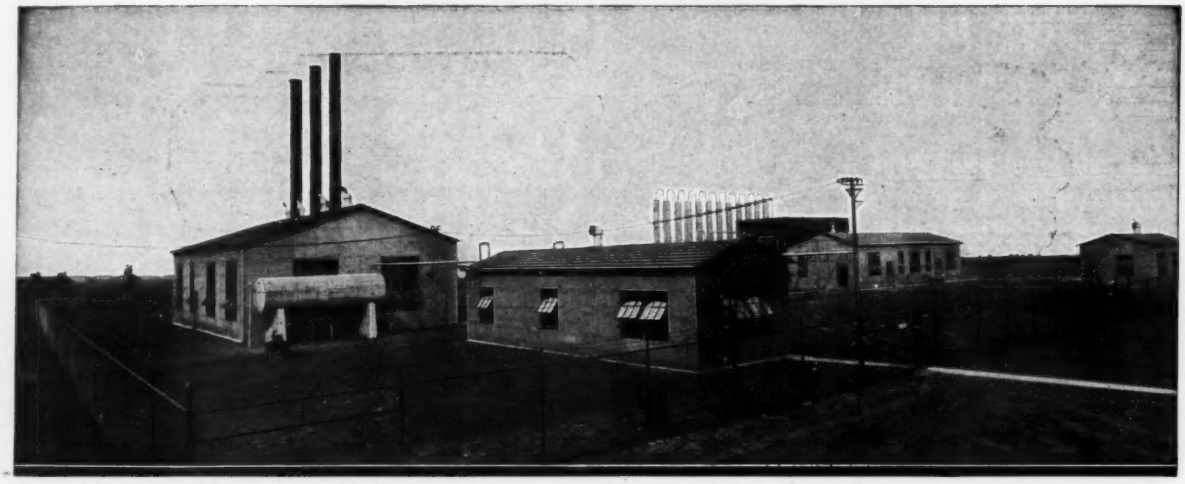
Frick Building, Pittsburgh, Pa.

"NATIONAL"

Mention Where You Saw the Advertisement

TRUSCON BUILDINGS

OF COPPER STEEL



For Use in Natural Gas Gasoline Plants

Vacuum Plants, Compression Plants, Machine Shops, Refrigeration Plants, Pump Houses, Laboratories, Garages

These permanent, non-combustible buildings can be shipped to you immediately right out of stock. They consist of standardized units of rust-resisting copper steel and are easily and quickly erected. Should it become necessary to change your plant location, these buildings by Truscon can be readily dismantled and re-erected elsewhere without loss. They are by far the most economical and practical construction for the money invested. Truscon Buildings are being used throughout the Oil Industry for a wide variety of purposes. Suggestions, information and estimates for a single building or an entire plant individualized to your exact requirements furnished without obligation.

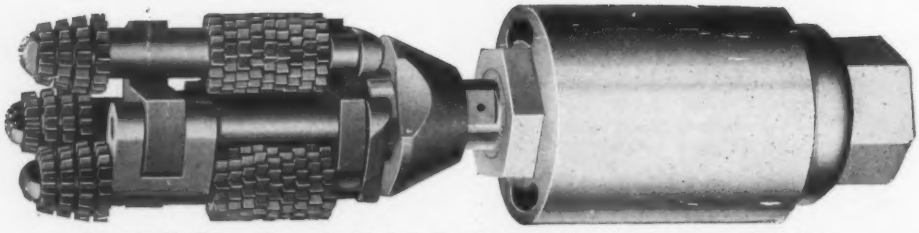
Write for Booklet on Truscon Buildings in use in the Oil Industry.

TRUSCON STEEL COMPANY, Youngstown, Ohio

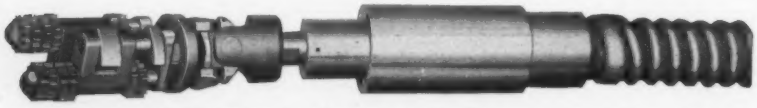
Established 1903

Warehouses and Offices in all Principal Cities.

every fouled tube in the refinery has its LAGONDA CLEANER

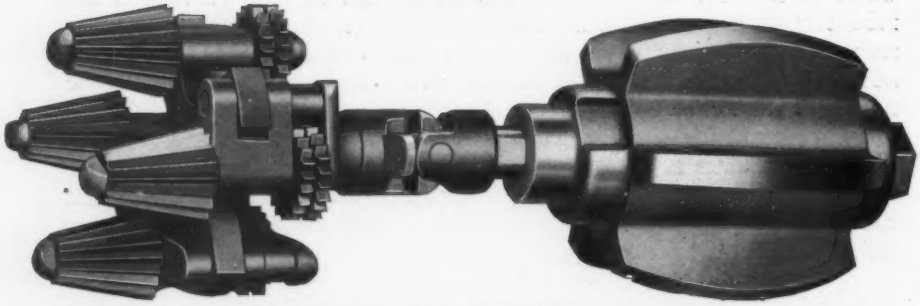


Lagonda Air Driven Cleaner for 3-inch I. D. tubes in cracking still furnace, equipped with long surface Quick Repair Head



Lagonda No. D-153 Cleaner for 2-inch curved pipe, as used in the residuum lines

Extension piece used between Universal Joint and Drill, increases the cutting range of Drill in large size tubes.



No. D-344 Lagonda Cleaner with sled runners, as used in 7⅝-inch I. D. curved vapor lines in Dubbs stills

The Lagonda Mfg. Co.
SPRINGFIELD, OHIO
FUEL SAVING SPECIALISTS

NEW YORK, CHICAGO, PHILADELPHIA, BOSTON, PITTSBURGH, CLEVELAND, CINCINNATI, DETROIT, SYRACUSE, BALTIMORE, ST. LOUIS, KANSAS CITY, DENVER, DALLAS, ATLANTA, SAN FRANCISCO, MONTREAL, LONDON.

X-1426

Makers of Lagonda Boiler Tube and Condenser Cleaners, Tube Cutters, Cap and Header Reseating Machines, etc.

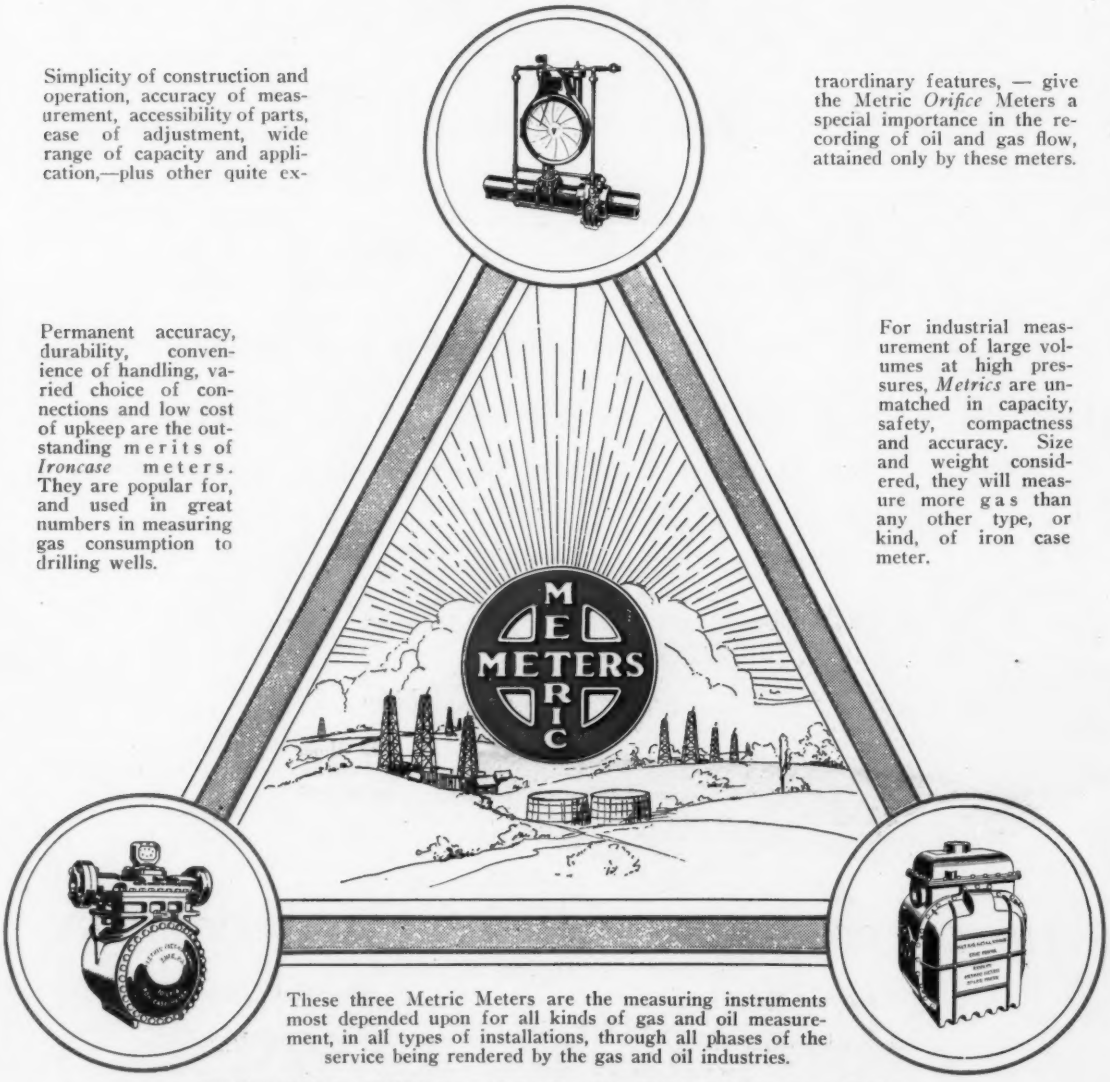
The Triumvirate of ACCURACY *in* MEASUREMENT

orifice

Simplicity of construction and operation, accuracy of measurement, accessibility of parts, ease of adjustment, wide range of capacity and application,—plus other quite extraordinary features, — give the Metric *Orifice* Meters a special importance in the recording of oil and gas flow, attained only by these meters.

Permanent accuracy, durability, convenience of handling, varied choice of connections and low cost of upkeep are the outstanding merits of *Ironcase* meters. They are popular for, and used in great numbers in measuring gas consumption to drilling wells.

For industrial measurement of large volumes at high pressures, *Metrics* are unmatched in capacity, safety, compactness and accuracy. Size and weight considered, they will measure more gas than any other type, or kind, of iron case meter.

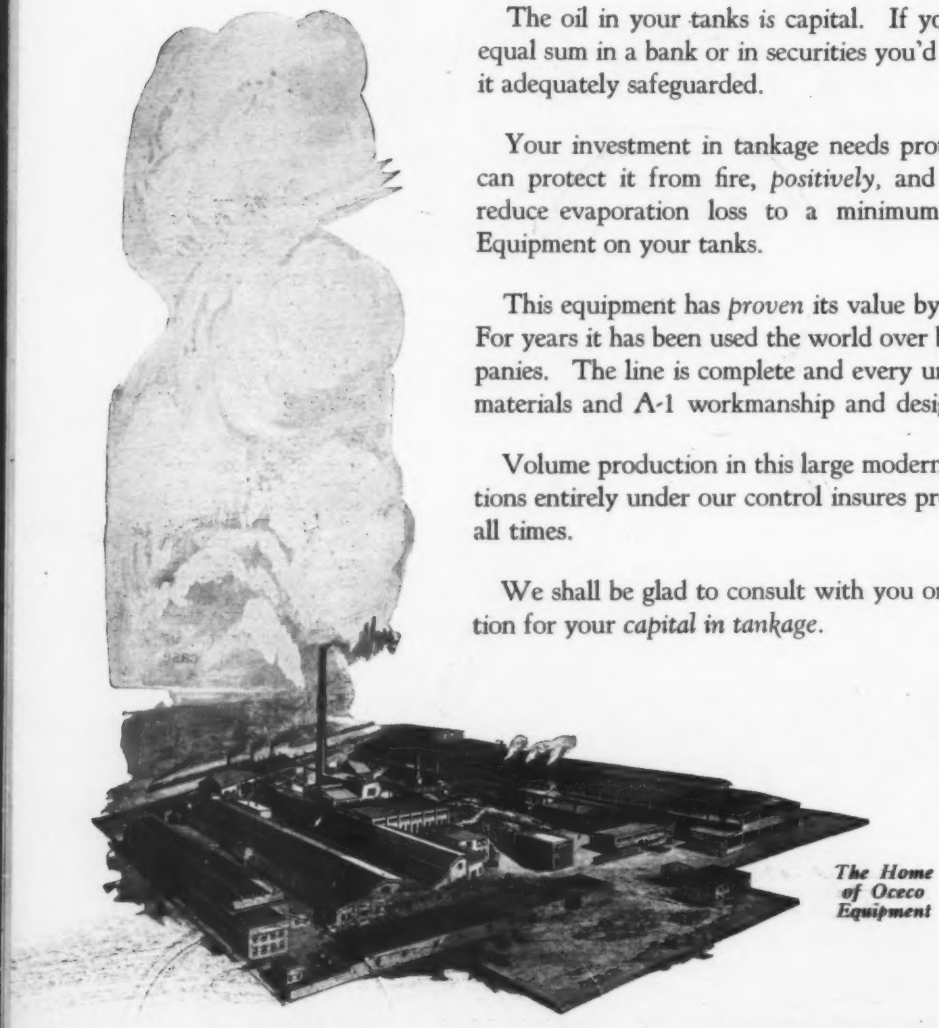


These three Metric Meters are the measuring instruments most depended upon for all kinds of gas and oil measurement, in all types of installations, through all phases of the service being rendered by the gas and oil industries.

WESTCOTT & GREIS, Inc.—Sales Service—Dallas—Tulsa—Los Angeles

IRONCASE METRIC METAL WORKS of the AMERICAN METER CO., Inc. ERIE PENNSYLVANIA **METRIC**

How Much Capital Have You Tied Up in Tankage?



The oil in your tanks *is* capital. If you were placing an equal sum in a bank or in securities you'd insist upon having it adequately safeguarded.

Your investment in tankage needs protection, too. You can protect it from fire, *positively*, and at the same time reduce evaporation loss to a minimum—by using Oceco Equipment on your tanks.

This equipment has *proven* its value by its service record. For years it has been used the world over by leading oil companies. The line is complete and every unit is of first grade materials and A-1 workmanship and design.

Volume production in this large modern plant with operations entirely under our control insures prompt shipments at all times.

We shall be glad to consult with you on adequate protection for your *capital in tankage*.

The Home of Oceco Equipment

THE OIL CONSERVATION ENGINEERING COMPANY

Headquarters for Tank Equipment

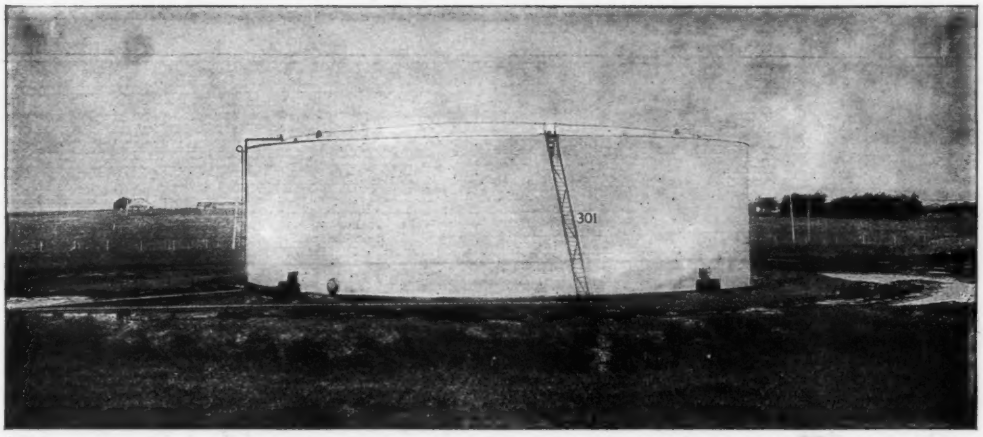
877 Addison Road **Cleveland, Ohio**

Engineering and Sales Service at:

25 Broadway, New York
O-S Building, Casper, Wyo.
417½ So. Boulder St., Tulsa, Okla.
Box 552, Beaumont, Texas
Neilan, Schumacher & Co., Los Angeles, Cal.

OIL TANK OCECO EQUIPMENT

SAVES EVAPORATION AND PREVENTS FIRE



Save Gas and Protect Your Tanks *with*

COOK'S "SUPER GAS-PROOF" TANK PAINT

COLOR is the first consideration in painting oil storage tanks. Scientists have proved that light-colored tank paints will save an evaporation loss of many barrels annually. It is folly to waste oil when so much can be saved by the use of the right paint.

Our "Super Gas-Proof Tank Paint, White" is absolutely fume-proof and will not discolor. It has a satin-like texture which resists dirt and remains clean even after years of service. It is economical for even the largest surfaces. It may be applied with either brush or spray; and it covers solidly.

The Physical and Chemical Laboratories of the Cook Paint & Varnish Company have specialized in developing paints for the oil industry. Cook Service Men know your maintenance painting problem. An inquiry places you under no obligation

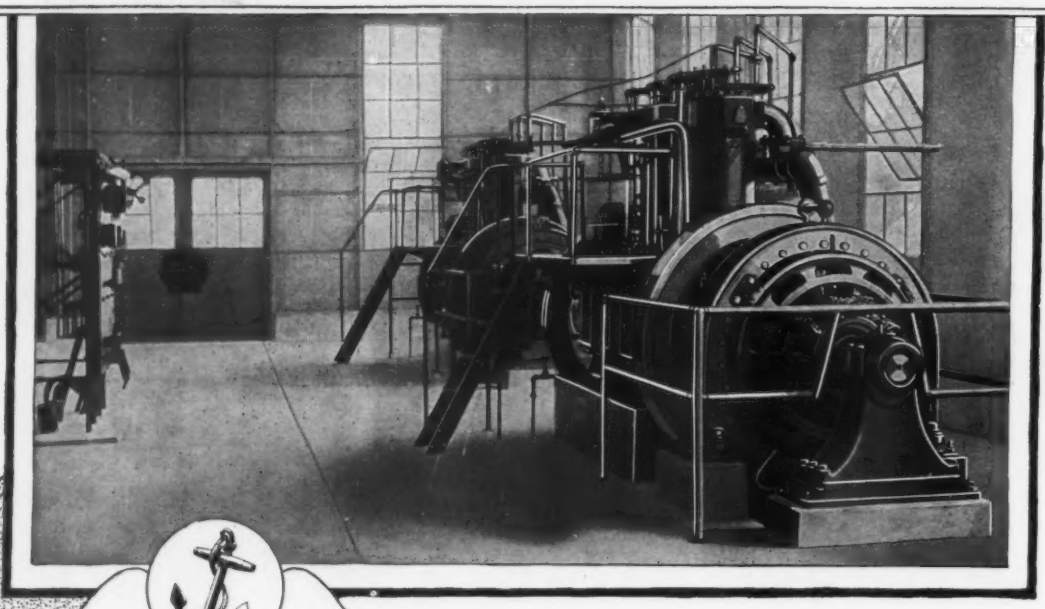
Five great factories and ten branches located in the heart of the mid-continent oil fields enable Cook's to give prompt service on your requirements.

COOK'S PRODUCTS

COOK PAINT & VARNISH COMPANY

FACTORIES: KANSAS CITY – ST. LOUIS – FORT WORTH – HOUSTON – CINCINNATI.
BRANCHES: CHICAGO – DETROIT – OMAHA – DENVER – WICHITA – DALLAS
TULSA – OKLAHOMA CITY – KANSAS CITY, KANS. – ST. JOSEPH, MO.

Have Every Station Unit of Equal Reliability



Hope Gas Engines for Dependable Auxiliary Power

It is just as vital to plan for the utmost of dependability in your auxiliaries, at a gas or oil line station, as to invest in high grade pumps and compressors.

On that basis the dictates of good judgment should lead you to follow the example set in the equipping of the 50 million cu. ft. per day gas line station pictured above and to install the ever-reliable Hope Vertical Gas Engines. A complete range of sizes is available.

Let us send you Catalogs and Specifications. Please mention the size you need.

H-E-40

ENGINEERS CONTRACTORS

HOPE ENGINEERING AND SUPPLY COMPANY

DESIGNERS MANUFACTURERS

MOUNT VERNON, OHIO, U.S.A.

DALLAS, TEX TULSA, OKLA. CASPER, WYO.

Mention Where You Saw the Advertisement

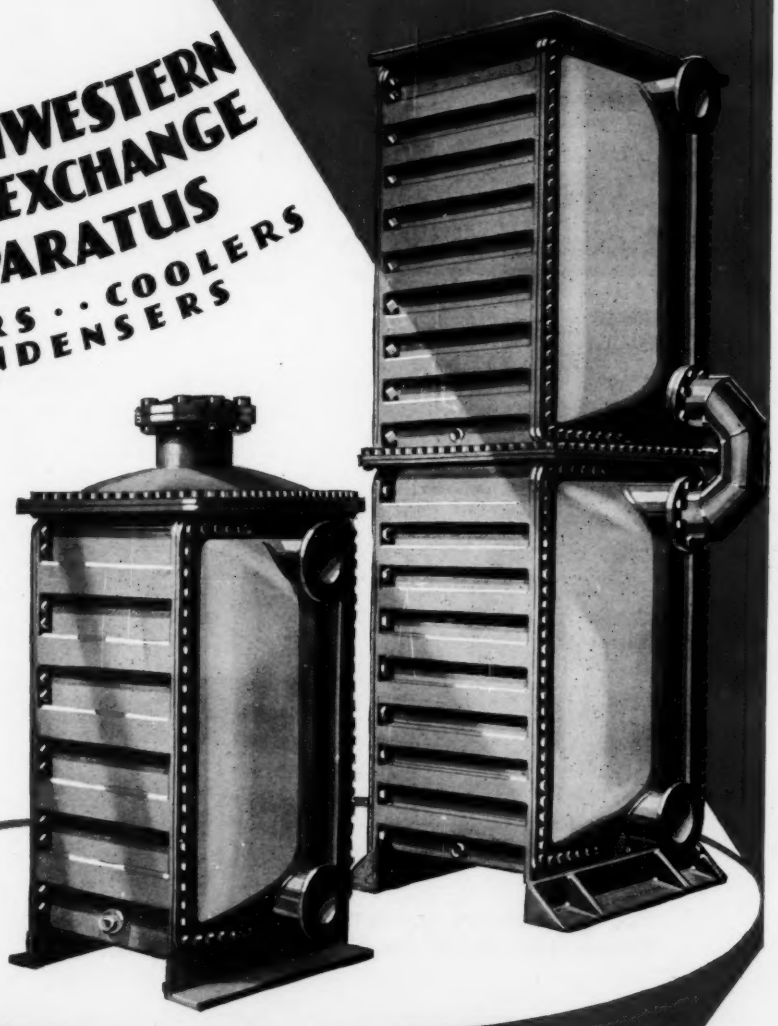
SOUTHWESTERN ENGINEERING CORPORATION
LOS ANGELES U.S.A.

SOUTHWESTERN Heat Exchange Apparatus for any and all capacities can be built up by manifolding the units as shown in the illustration. Special construction allows for a wide range in temperatures and pressures.

Flexible . . . Efficient
Dependable

SOUTHWESTERN HEAT EXCHANGE APPARATUS

HEATERS . . COOLERS
CONDENSERS



SOUTHWESTERN ENGINEERING CORP
1221 HOLLINGSWORTH BLDG
Los Angeles, Calif.

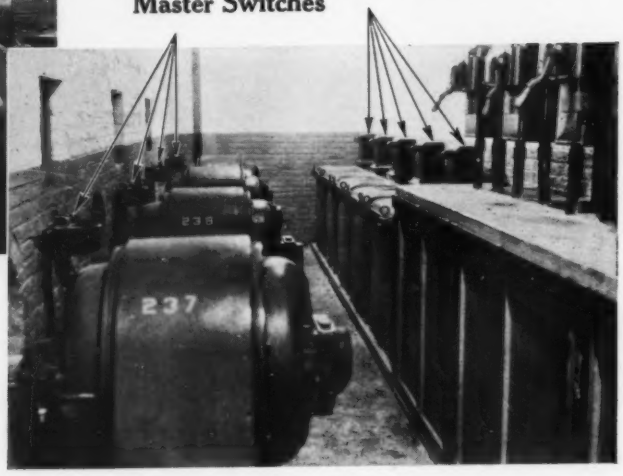
Branch
Joplin National Bank Bldg.
Joplin, Missouri

and
90 WEST STREET, NEW YORK CITY

Branch
Western Bldg., Amarillo, Tex.
Mayo Bldg., Tulsa, Okla.

EC&M Automatic Compensators

Oil-Immersed Master Switches



Flame Proof

Because Oil-Immersed

This Oil Refinery has taken every precaution to eliminate Fire Hazards. The Starters for these 100 HP., 2300 Volt Motors are EC&M Oil-Immersed Automatic Compensators.

The master switches are also oil-immersed. One is located at each motor for local control and there is one at each pump for remote control.

Why run the risk of a disastrous fire when EC&M Oil-Immersed Automatic Starters are 100% safe?

EC&M High Voltage Compensator

Send for Bulletins 1042-F, 1047 and 1048.

See Our Exhibit at the International Petroleum Exposition, Tulsa, Okla., Sept. 24th to Oct. 1st.

THE ELECTRIC CONTROLLER & MFG. CO.

CLEVELAND, OHIO

NEW YORK-50 CHURCH ST. CHICAGO-CONWAY BLDG. DETROIT-DIME BANK BLDG. BIRMINGHAM-BROWN-MARX BLDG. CINCINNATI-1ST NATIONAL BANK BLDG. MONTREAL-DRUMMOND BLDG. LOS ANGELES-AMERICAN BANK BLDG. SALT LAKE CITY-228 W. SO. TEMPLE TORONTO-REFORD BLDG. PHILADELPHIA-WITHERSPOON BLDG. PITTSBURGH-OLIVER BLDG. SAN FRANCISCO-CALL BUILDING SEATTLE-570 COLMAN BLDG. TULSA-217 E. ARCHER ST.

The four machines at both our plants have given remarkably good service

We find the machines very easy to handle

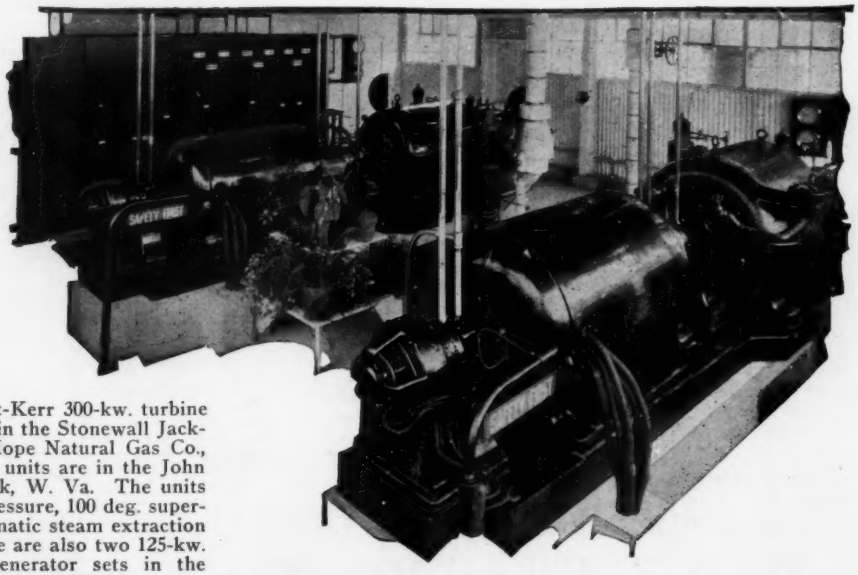
-- two years of continuous running -- no expense for repairs -- far as we can see they will keep on running indefinitely.

-- our two plants are entirely dependent on these turbines -- we have found them very trustworthy --

We have found the regulation of these machines very good --

The gist of a letter about ELLIOTT TURBINES

from the Hope Natural Gas Company, Clarksburg, W. Va.



These are two of the four Elliott-Kerr 300-kw. turbine generators referred to. They are in the Stonewall Jackson Compressor station of the Hope Natural Gas Co., at Chelyan, W. Va. Two similar units are in the John Cornwell Station at Barren Creek, W. Va. The units are designed for 175 lbs. initial pressure, 100 deg. superheat, 28-in. vacuum, and for automatic steam extraction at 10 lbs. bleeder pressure. There are also two 125-kw. Elliott-Kerr condensing turbo-generator sets in the Hope Natural Gas Station at Hastings, W. Va.

Elliott Power Equipment includes engines and turbines, generators and electrical machinery, condensers, de-aerators, centrifugal blowers and accessory equipment.

ELLIOTT COMPANY H-507

PITTSBURGH, PA.

General Offices **JEANNETTE, PA.**

Sales Offices in principal cities

Mention Where You Saw the Advertisement

Making Good the Guarantee

Williams Double-Disc Gate Valve No. 127—representing the height of valve service. Ask your dealer for it.

No effort to shirk responsibility! No grumbling over severity of the service demanded! No "ifs or ands" or quibbling of any nature!

Service at a profit! That is the plainly understood proposition on which all **Williams Valves** are sold. Discriminating valve buyers know the **Williams** saves coal, labor, time and trouble, and assures uninterrupted production. Profits from such service are incalculable.

Williams Double-Disc Gate Valve No. 127

is one of the peerless **Williams** line that is famed for abolishment of all waste—for the insurance of a full, steady and leakless flow of Air, Steam, Water, Gas or Oil.

A tight seat is assured by the ball and socket bearing discs that also compensate for any temperature distortion or sagging of pipe lines.

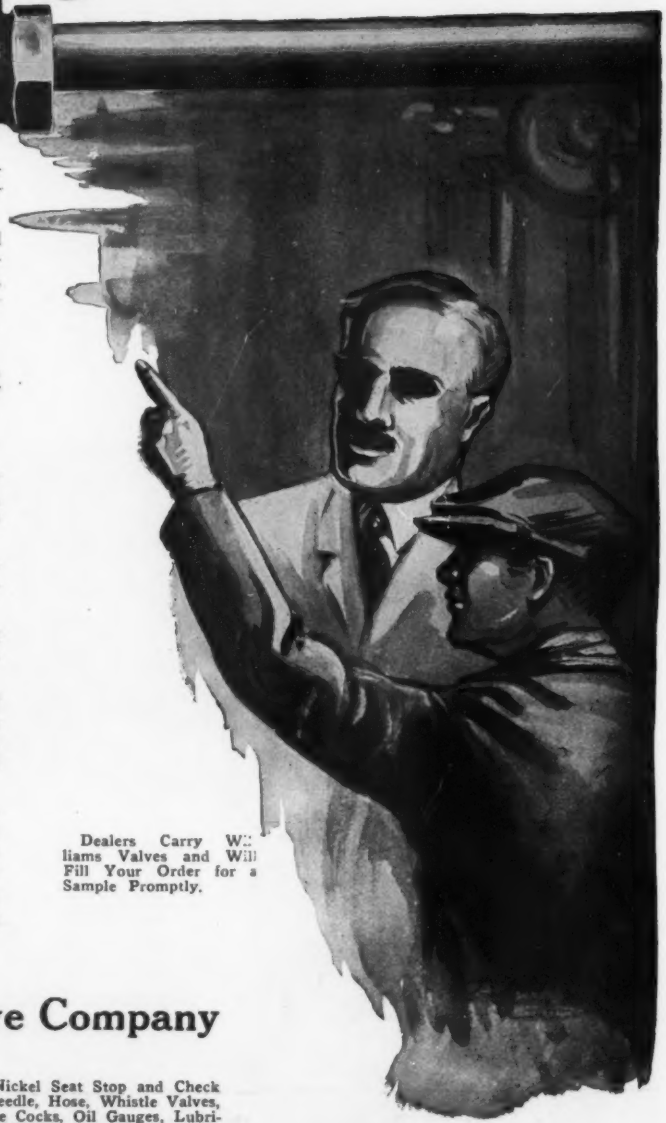
An **exclusive** Williams feature is the Union Ring method of securing the bonnet to the body, providing a rigid, steam-tight joint that cannot corrode.

The heaviest stem used in any gate valve—made of special hard bronze that will not bend or break. Acme Standard threads assure maximum wear and long life. Packing is forced against the stem by a Packing Gland Follower.

Many other features that explain the extremely satisfactory service of Williams Valves are described in our Catalogue 10. It clearly explains why Williams Double-Disc Gate Valve No. 127 always makes good.

Made in two patterns—Medium for 200 lbs. pressure and Extra Heavy for 300 lbs. pressure.. **Satisfaction Guaranteed.**

Catalogue No. 10 mailed on request.



Dealers Carry Williams Valves and Will Fill Your Order for a Sample Promptly.

The D. T. Williams Valve Company

Cincinnati, Ohio

Makers of High Grade Bronze and Iron, Regrinding and Nickel Seat Stop and Check Valves, Gate, Blowoff, Hydraulic, Swing and Ball Check, Needle, Hose, Whistle Valves, Stop and Air Cocks, Unions, Fittings, Water Gauges, Gauge Cocks, Oil Gauges, Lubricators, Oil and Grease Cups, Steam Traps, Separators.

Williams Valves

Mention Where You Saw the Advertisement

LACLEDE FIRE BRICK

The Choice of Leading Refiners

A few of our "blue ribbon" customers amongst the oil producers and refiners are:

Standard Oil Company
The Texas Company
Gulf Refining Company
Sinclair Refining Company
Roxana Petroleum Corporation

In Laclede Fire Brick you get *quality;* you get *lowest-cost-per-year;* you get courteous, efficient *service;* you get *prompt deliveries;* you get the *right price.* Write for a quotation.

And They Cost No More Than Ordinary Fire Brick

LACLEDE-CHRISTY, St. Louis, U. S. A.

A Combination That Can't Be Beat—

Laclede-Christy Bolted Arch Construction

and

Laclede-Christy Arch Tile

LR14

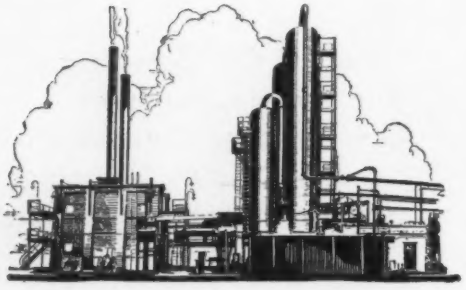
KELLOGG PIPE STILLS

ACTUAL THRUPUT

30% greater

Kellogg pipe stills are guaranteed for a specified rated capacity. They are designed, however, not only to produce this capacity, but also to have an adequate reserve for overloading.

At a certain Texas refinery, a Kellogg still was installed for handling 2500 bbls. of topped crude a day. In actual everyday operation, this plant is showing an average daily thruput of over 30% more capacity. And all the products are meeting specifications.



KELLOGG

CROSS CRACKING PLANTS—BUBBLE TOWERS—PIPE STILLS—HEAT EXCHANGERS—GRAY TREATING TOWERS—TREATING PLANTS

THE M. W. KELLOGG CO., 7 DEY STREET — NEW YORK

KANSAS CITY, MO., 700 BALTIMORE AVE. — SAN FRANCISCO, CAL., 444 MARKET ST.

LOS ANGELES, CAL., 329 PETROLEUM SECURITIES BLDG.

A heat exchanger and condenser in one

Note the multiple shells of the G-R Sectional Condenser

The sectional arrangement of this condenser provides many special operating advantages. Sections can be added to or removed to meet varying capacity requirements. The complete unit is readily transported and re-assembled if necessary to meet changing plant conditions. Inspection and cleaning are greatly facilitated. There are many additional advantages in the special design and construction of the G-R Sectional Condenser. Its special features are concisely described in leaflet which will be sent on request.

THE GRISCOM-RUSSELL COMPANY
285 Madison Ave., New York

Philadelphia	Chicago	St. Louis	San Francisco
Boston	Cleveland	Kansas City	Los Angeles
Rochester	Detroit	Charlotte	Seattle
Pittsburgh	Milwaukee	New Orleans	Denver
Columbus	Indianapolis	Houston	Salt Lake City
Atlanta	Minneapolis	Dallas	Tulsa

For Canada: Riley Engineering and Supply Company, Ltd., Toronto

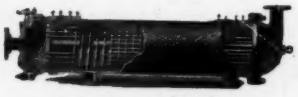
Note these other G-R Units for lower repairing costs

Mineral Seal Oil Heat Exchangers

A compact, twin exchanger with strict counter-current flow to promote maximum rate of heat interchange.

G-R Vaneflo Gas Cooler

for cooling casing head or natural gas. Can be used as inter-, after-, or precooler in absorption and compression type natural gasoline plants. Has low pressure loss and exceptional efficiency.



G-R Jacket Water Cooler

uses any source of raw water to cool the jacket water from oil and gas engines and compressor. The famous Multiwhirl Cooler—thousands in operation in every liquid cooling service.

G-R Gasoline Condenser

for condensing natural gasoline vapors in casinghead gasoline plants. Can also be used as a knockout box or fractionating tower control section with particularly close control of the end points.

G-R Twin Heat Exchanger

for the efficient interchange of heat between crude oil feed stock and still bottoms, cold water and hot oil, etc.

Griscom-Russell

Heat Transfer Apparatus

These Distributors stock ADAMANT in 100 lb., 250 lb., and 400 lb. containers. Distributors are listed under state and city, with states arranged alphabetically.

Alabama, Birmingham,
Young and Vann Supply Company
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California, San Francisco,
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Colorado, Denver,
H. W. Thompson
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Rackliffe Bros. Co., Inc.
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Illinois, Chicago,
Wm. E. Dee Company
Indiana, Fort Wayne,
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Louisiana, Shreveport,
Woodward Wight & Company, Ltd.
Maryland, Baltimore,
King's Coal and Supply Company, Inc.
Massachusetts, Boston,
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Waldo Bros. and Bond Company
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Union Material & Supply Co.
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Nebraska, Omaha,
American Machinery & Supply Co.
New York, Buffalo,
The Curtis Supply Co., Inc.
New York, Mohawk,
The American Hard Wall Plaster Co.
New York, New York,
C. C. Phillips, 110 W. 34th St.
New York, Rochester,
American Clay & Cement Corp.
Wm. Summerhays & Son
New York, Rome,
The American Hard Wall Plaster Co.
New York, Syracuse,
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Southern Steel & Cement Company
Ohio, Cincinnati,
The Wm. T. Johnston Co.
Ohio, Cleveland,
The Cleveland Tool & Supply Co.
Ohio, Columbus,
The Westwater Supply Co.
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Oklahoma, Tulsa,
Standard Asbestos & Cork Company
Oregon, Portland,
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Pennsylvania, Aspinwall,
The Gas Combustion Company
Pennsylvania, Bethlehem,
Morris Black
Pennsylvania, Erie,
O. C. Thayer and Son
Pennsylvania, Pittsburgh,
The Gas Combustion Company
Post Office Box No. 1753
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Reading Foundry and Supply Co.
Rhode Island, Providence,
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Norvell-Wilder Hardware Company
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San Antonio Machine & Supply Co.
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Geo. S. Thomson Company
Texas, Houston,
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San Antonio Machine & Supply Co.
Texas, Waco,
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Real Protection—
Applied With The ADAMANT Gun

$25.00 paid for The ADAMANT Gun which applied the coatings of the ADAMANT-ADACHROME Mixtures on this side wall in a Foster still.

Now the structure has a refractory surfacing that provides *real* protection from destructive elements. It is highly resistant to clinker adhesion, slags, fusible coal ash, sulphur and other impurities in either coal or oil fuel which cause slagging, fluxing or melting of brick.

Why not give this *real* protection to your boiler furnace brickwork, still settings and other refractory construction? The equipment—The ADAMANT Gun—costs you only $25.00!

May we send you complete particulars on this method of imparting longer life to your brick-work? Write for copies of the new booklets on The ADAMANT Gun and the ADAMANT-ADACHROME Mixtures.

Botfield Refractories Co.

783 S. Swanson St., Philadelphia, Pa.

For A Long Furnace Run, Use The ADAMANT *Gun*

ADAMANT
FIRE BRICK CEMENT

Whenever You Use a Fire Brick, Use ADAMANT, *The Original High Temperature Cement*

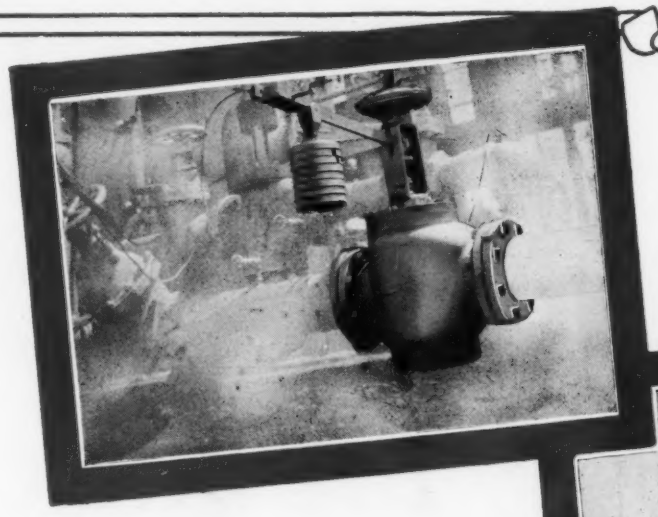
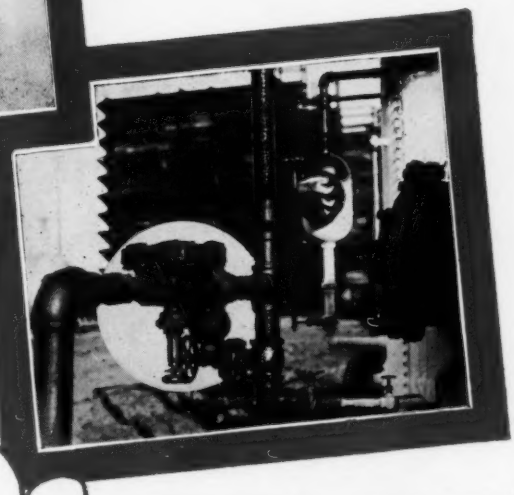


Illustration above shows Type 14 maintaining 40 pounds gas pressure on absorbers at Hull plant.

Illustration below shows Type 295 Fisher Back Pressure Control Valve, operating on stabilizers in Natural Gasoline plant, Oklahoma.



BACK PRESSURE AND RELIEF VALVES

Back pressure can be easily maintained by using the Fisher Type 14 Automatic Relief Valve.

This valve is recommended for use on any installation where the desired pressure must be maintained exactly and any excess pressure relieved.

The valve is absolutely automatic, opening at the fixed working pressure and closing promptly after relieving the excess pressure above the fixed working point, so that except within the narrowest working limits, the pressure never exceeds the point for which the valve is set.

FISHER
TRADE MARK REGISTERED

The reliability of this Automatic Relief Valve is a source of great satisfaction to plant operators.

The control of pressures may safely be left up to these varied types of Fisher Back Pressure or Relief Valves.

Each type is designed and built to meet certain conditions, and among these types is one that will serve your purpose. The types are 295—14—9—9F.

THE FISHER GOVERNOR COMPANY

1317 FISHER BUILDING

MARSHALLTOWN, IOWA, U.S.A.

Mention Where You Saw the Advertisement

Now used by Refiners who once thought more costly fire brick necessary

Athens Brick & Tile Co.,
Athens, Texas

Elgin Butler Brick Co.,
Austin, Texas

Texas Clay Products Co.,
Malakoff, Texas

Acme Brick Co.,
Ft. Worth, Texas

Write—let us give you the facts concerning the Refractory Efficiency and lower local freight rates of

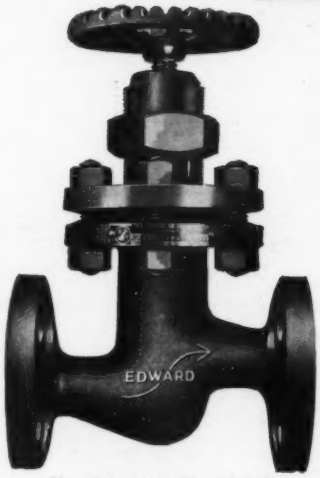
TEXAS FIRE BRICK

Address any member of the

Texas Fire Brick Mfgrs. Ass'n

PROMOTING TEXAS FIRE BRICK ECONOMIES

—for Forged Steel Valves?



No. 866—600 lb. Flanged End, Flanged Bonnet, O. S. & Y. Globe Valve

Why EDWARD of course!

For fourteen years **Edward forged steel** valves have been marketed as a standardized product.

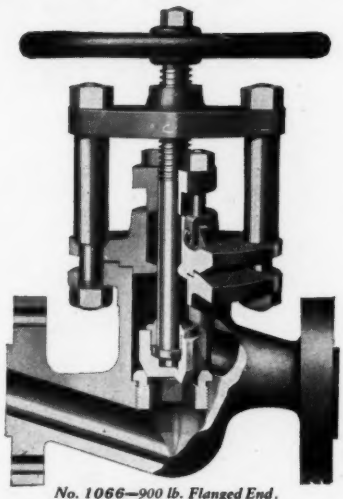
Even as pioneers, Edward fostered the principle of general use of **forged steel** small valves in preference to valves of cast materials.

This theory is now finding great favor as indicated by the wholesale selection and very definite preference for **forged steel** in the moderate classes of service as well as the more severe.

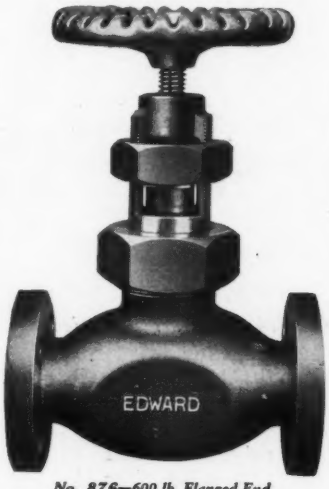
Edward continued leadership is evidenced by its variety of advanced designs.

Therefore—if it is **forged steel valves** you want—put your requirements up to Edward.

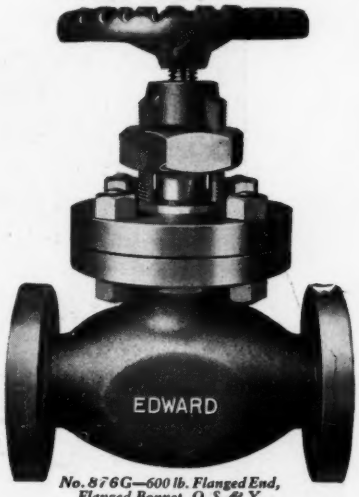
Complete data and prices sent upon request.



No. 1066—900 lb. Flanged End, Flanged Bonnet, Globe Valve

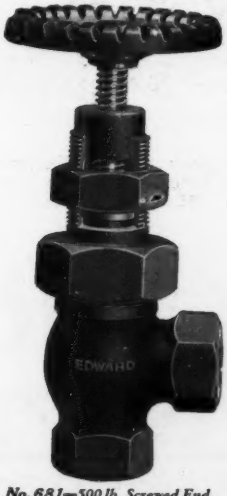


No. 876—600 lb. Flanged End, Union Bonnet, O. S. & Y. Globe Valve



No. 876G—600 lb. Flanged End, Flanged Bonnet, O. S. & Y. Globe Valve

No. 682—300 lb. Screwed End, Union Bonnet Globe Valve



No. 681—300 lb. Screwed End, Union Bonnet Angle Valve

No. 680G—300 lb. Screwed End, Flanged Bonnet, O. S. & Y. Globe Valve

The Edward Valve & Manufacturing Co.

Main Office and Works:
East Chicago, Ind.

2000 Harrington Street, P. O. Box 1402, Houston, Texas

Chapman Valve Mfg. Co., P. O. Box 974, Tulsa, Okla.

Why These Plants Use *Softened* Water

Sinclair Oil & Gas Company
Phillips Petroleum Company
Globe Gasoline Company
Marine Refining Company
Shaffer Oil & Refining Co.
Amerada Petroleum Corporation
Wentz Oil Corporation
The Empire Companies
Gilmore Oil Company

—all of which are equipped with Paige-Jones Rapid Rate Upward Flow, Zeolite Water Softeners.

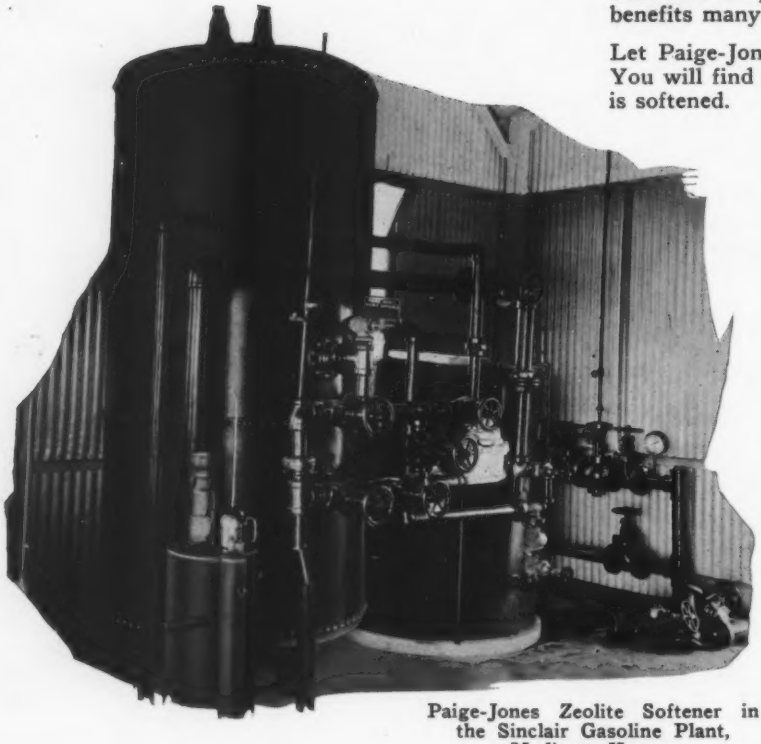
Most natural gasoline plants seem to have landed where hard water is the rule rather than the exception.

As a result, they face added production burdens and higher costs.

But many have overcome their troubles by softening the water—condensing is better controlled, coils are much cleaner, cylinder heads do not crack.

The cost of providing soft water is moderate—the benefits many.

Let Paige-Jones engineers fix up your water supply. You will find a big improvement if the cooling water is softened.



Paige-Jones Zeolite Softener in the Sinclair Gasoline Plant, Madison, Kansas

PAIGE & JONES CHEMICAL CO., INC.
General Sales Office, Technical Dept. and Works,
HAMMOND, INDIANA
Executive Office: 461 FOURTH AVE., NEW YORK
Offices in Principal Cities

Be Assured Of Paige-Jones Economies

Paige-Jones originated and developed the *rapid rate upward flow* zeolite softener. This is by far the more economical zeolite system.

PAIGE-JONES WATER SOFTENING

ZEOLITE AND LIME SODA SOFTENERS · PRESSURE SAND FILTERS ·
BOILER FEED WATER TREATMENTS · HOUSEHOLD WATER SOFTENERS ·

Mention Where You Saw the Advertisement

What Makes the Difference in Refinery Equipment

WORKMANSHIP—that's the answer. Refining equipment can be no better than the ability of the men who build it. It takes long experience and expert skill to build refining equipment that will stand the tests of time and weather.

—And that's the secret behind KAW-built products—the reason why they are known throughout the industry as being "Better Built for Longer Service." KAW workmen are veterans at steel fabrication. Years of experience and expert training stand behind them in every job they turn out.

There is a difference in refining equipment and that difference in KAW Products will mean money saved for you. Write, wire or phone for specifications and prices.

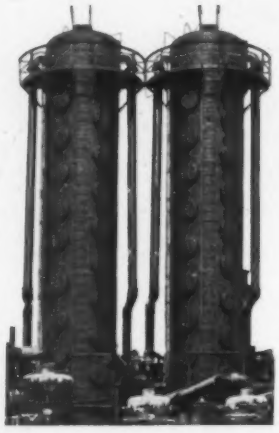
KAW

KAW STEEL CONSTRUCTION CO.

General Office & Plant:
1st & Walker Ave., Kansas City, Kan.

BUBBLE TOWERS—

Special Fractionating and Absorption equipment



General Refinery Design and Construction

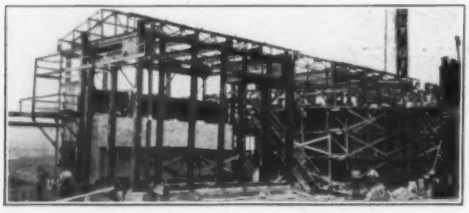
WE solicit an opportunity to show what our equipment will do in your plant toward increasing yields of the more valuable products as well as reducing operating costs.

We will be pleased to have you inspect any of our numerous installations to see the results attained and how they stand up under hard service.

We will consider it a privilege to be allowed to send an engineer to your plant at our own expense to determine if your recoveries can be increased or your operating costs reduced, what equipment would be necessary to effect these results, and the cost of such equipment.

We believe the fact that over 65% of our business is repeat orders is a better testimonial to the merit of our equipment than anything we might say.

Write for Brochure.



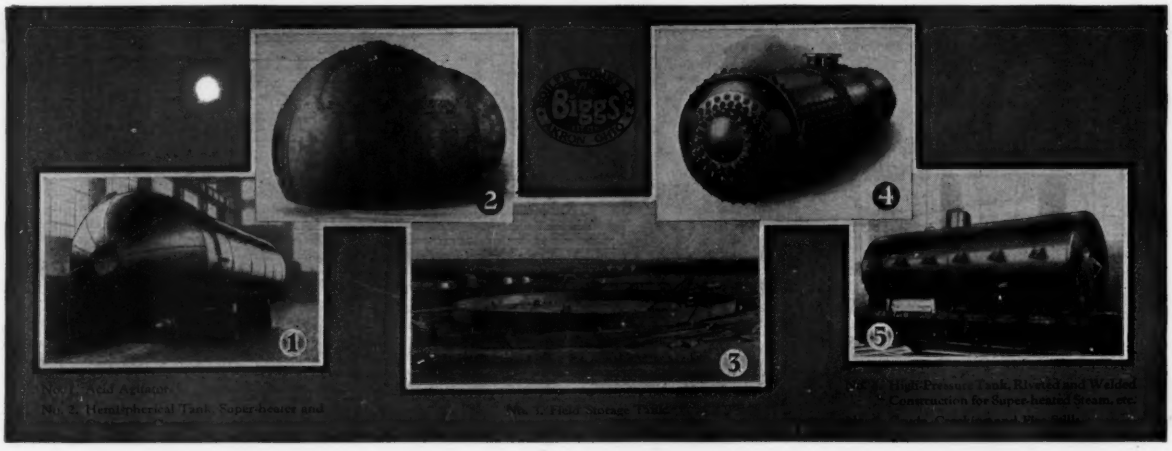
PIPE STILLS

The WINKLER-KOCH ENGINEERING CO.

Consulting and Construction Engineers

429 FIRST NATIONAL BANK BLDG.

WICHITA KANSAS



This One Responsible Source of Supply Covers Every Heavy Steel Plate Requirement

Biggs designs, fabricates and erects any and every kind of standard or special heavy steel plate work required by the petroleum industry.

Whatever your requirements may be, the Biggs organization is keyed up to handle them quickly, accurately and economically. The illustrations above are typical of Biggs service and Biggs ability.

From original layout to final delivery, every conceivable operation necessary to the satisfactory completion of the job is done with the machine-like precision and painstaking attention to detail engendered by 40 year's experience in heavy steel plate construction.

In the field—at the refinery—wherever you are situated—you can safely rely on Biggs for efficient, leak-proof construction and prompt, schedule-meeting delivery.

Manufacturers of

- Pressure Stills for Cracking Process
- Fractionating Towers
- Dephlegmating Towers
- Bubble Towers
- Heat Exchangers
- Agitators
- Steam Stills
- Crude Stills
- Condenser Boxes
- Run Down Tanks
- Blending Tanks
- Hemispherical Tanks
- Blow Cases
- Acid Tanks
- Compounding Kettles
- Storage Tanks to 80,000 Barrels
- Smoke Stacks and Breechings, etc.

The coupon below will take you on a pictorial tour of the mammoth Biggs plant at Akron. Mail it today.

THE BIGGS BOILER WORKS COMPANY

General Offices and Works: Akron (25) Ohio
Eastern Sales Office: 300 Madison Ave., New York City
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The Biggs Boiler Works Co. Akron Ohio Est 1887 — TRADE MARK REGISTERED

TANKS AND GENERAL STEEL PLATE WORK *for the Oil Industry*

Now is the right time to mail this coupon

THE BIGGS BOILER WORKS COMPANY
Akron (25) Ohio

Please send us, without obligation, a copy of "What Biggs Does, and How." We are interested in the following equipment.....

Please see us on or about .....

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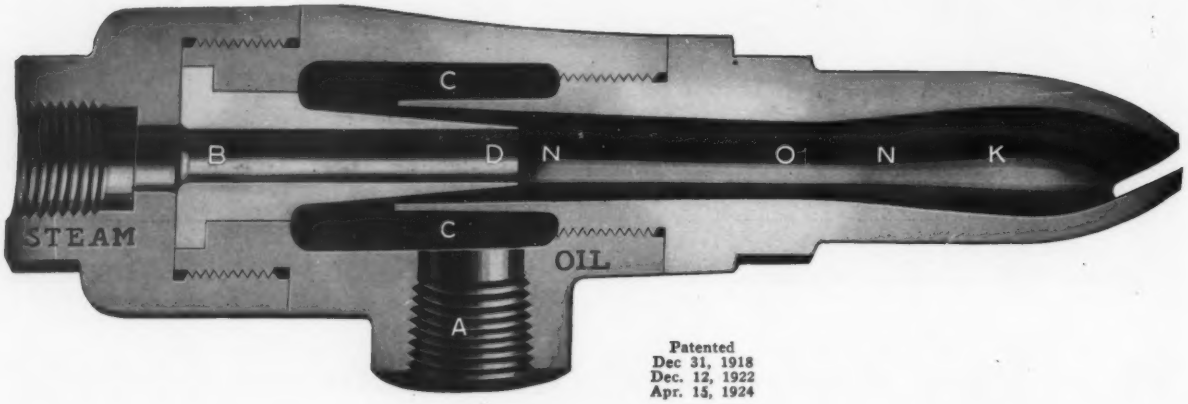
National Airoil Burners



Patented
Dec 31, 1918
Dec. 12, 1922
Apr. 15, 1924

For Power Plants and Stills and all Industrial Furnaces

NATIONAL AIROIL BURNERS
are internal atomizing burners—inside mixers —operating with either steam or compressed air; and burn as steady as a gas flame with any grade of fuel. Set your fire the way you want it, and it will burn the day through without watching or readjusting.

NATIONAL AIROIL BURNERS
will handle the heavy residuum from cracking stills without requiring continual removal for cleaning, an immense factor in economical plant operation.

NATIONAL AIROIL BURNERS
when operating under boilers will use less than one per cent of the steam for atomizing the oil. The old style steam atomizing burners use from three to seven per cent.

NATIONAL AIROIL BURNERS
give a soft gaseous flame that does not injure brick work or boiler tubes. Made with flat or round tips.

Write for our Bulletin No. 21

National Airoil Burner Company

Factory: S. W. Cor. 9th and Thompson Sts.
Sales Rooms: 1327 Girard Avenue
PHILADELPHIA, PA.

Oil Burners and Oil Burning Equipment

ANNOUNCEMENT

of

CONSOLIDATION

by the

POWER SPECIALTY COMPANY

and the

WHEELER CONDENSER AND ENGINEERING CO.

under the new name of

FOSTER WHEELER CORPORATION

This combination of non-competitive interests operating in the same fields will effect material economies and betterments of importance to owners and purchasers of auxiliary power plant equipment and oil refinery apparatus.

The time proven Foster, Wheeler and Aero products will be continued.

The management of the new corporation will remain in the hands of those executives and engineers who have been responsible for the successful development of the products and organizations for more than twenty years.

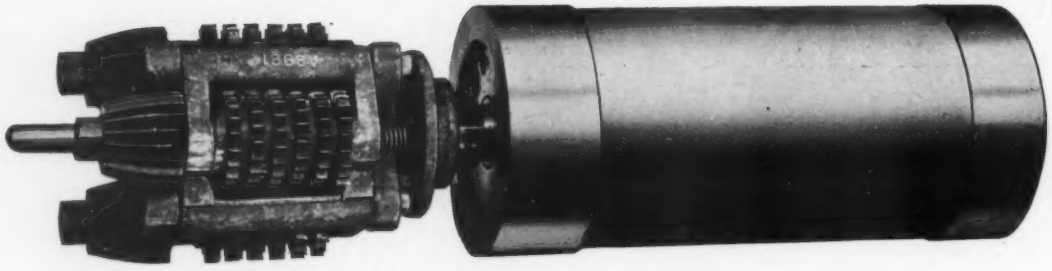
FOSTER WHEELER CORPORATION

111 Broadway, New York, N. Y.

Branches in principal cities of the United States, Montreal and Toronto, Canada, London, England.

WORKS: Carteret, New Jersey, Dansville and Newburgh, New York, St. Catharines, Ontario, Canada, and Egham, Surrey, England.

ROTO TUBE CLEANERS



Roto Air-Driven Heavy Duty Cleaner
For

CRACKING STILLS

THE ROTO CO. **Sussex Avenue and Newark St.,** **NEWARK, N. J.**

SEAMLESS STEEL STILL TUBES

Thousands of Babcock & Wilcox open hearth seamless steel still tubes are in service in refineries throughout the country.

These tubes have been supplied to various specifications, either with plain ends or upset as ordered.

Many of them are thirty feet long, made hot finished by a process perfected by this Company, for tubes of unusually long length.

The more common sizes are carried in stock at the Mill for immediate shipment.

THE BABCOCK & WILCOX TUBE CO

Works: Beaver Falls, Pa.
General Sales Office: 85 Liberty Street, New York

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BOSTON .....80 Federal Street
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THE BABCOCK & WILCOX TUBE CO. TUBES

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DENVER .....444 Seventeenth Street
SALT LAKE CITY .....Kearns Building
SEATTLE .....L. C. Smith Building
SAN FRANCISCO .....Sheldon Building
LOS ANGELES .....Central Building
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SAN JUAN, PORTO RICO ..Royal Bank Building
HONOLULU, H. T.....Castle & Cooke Building

SUNOCO

Let's talk it *over*

While attending the International Petroleum Exposition September 24th to October 1st is a good time to visit our Tulsa office and let us show you samples and explain the merits of these two oils. You are cordially welcome.

SUNOCO Absorption Oils

630

Increase your daily gasoline production.

Lower your manufacturing cost per gallon of gasoline produced.

Control your end points.

670

SUN COMPANY

Petroleum Bldg., Tulsa, Oklahoma

Refineries at

Marcus Hook, Pa. Yale, Oklahoma Toledo, Ohio

Universal Mist Extractor

Endorsed and adopted by Producers, Refiners and Engineers BECAUSE

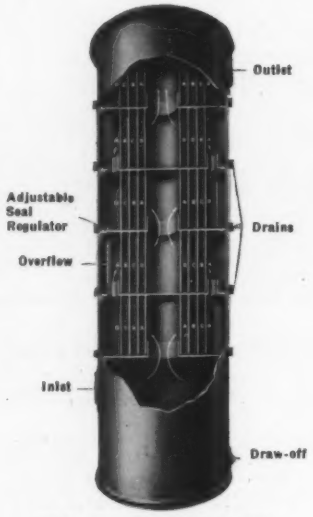
It provides CLEAN gas for the Absorption or Casinghead plant.

Does away with LIVERED absorption oil.

PREVENTS stills from FOAMING.

It insures CLEAN gas for distribution lines and ADDITIONAL OIL for the producer.

Removes WATER from gas leaving Charcoal Absorption Plant.



White Arrow Shows Path of Gas

It will, in refineries, result in lower end points, less treating and higher yields.

Can be used to remove suspended oil from "tail-house" gases.

Can be installed for pipe or cylindrical stills to remove all unvaporized oil held in suspension before vapors reach dephlegmators.

It operates under pressure or Vacuum.

It operates without excessive back pressure.

For sizes, specifications, prices and further information write to

OIL ENGINEERING COMPANY

WRIGHT-CALLENDER BUILDING LOS ANGELES, CALIFORNIA

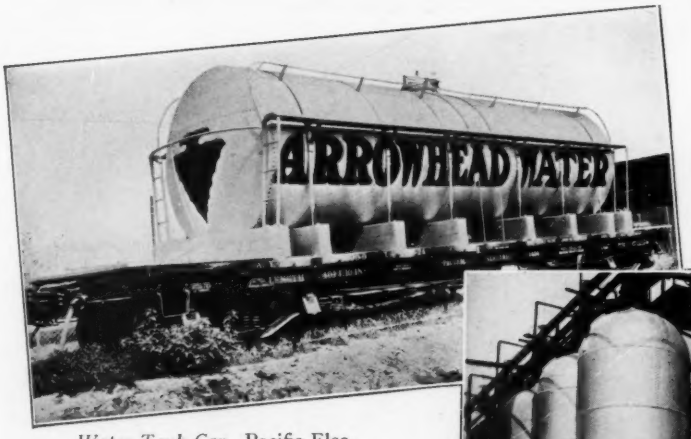
G O E T Z E

Metal-Asbestos Gaskets *for* Modern Refinery Practice

Write for this 36-page "Guide"

Goetze Gasket & Packing Co.

28 Allen Ave., **New Brunswick, N. Y.**



Water Tank Car—Pacific Electric Company, Los Angeles, California. One sprayed coat of Bitulumin.

Gasoline Retorts—Associated Oil Company, Avon Refinery, California. Two coats Bitulumin over 250 Iron Primer.

SUNLIGHT AND MOISTURE CHIEF CAUSES OF EXPOSED METAL SURFACE BREAKDOWN

BITULUMIN Deflects Harmful Ultra Violet Sunrays. Prevents Corrosion from Moisture Penetration. Minimizes Evaporation Through Keeping Tank Surfaces Cooler. For many other purposes, too.

BITULUMIN (Aluminum Paint) resists paint's two worst enemies, sunlight and moisture. It is largely immune to harmful ultra violet rays which break down ordinary paint surface allowing moisture to penetrate.

BITULUMIN forms a light-resisting, durable and moisture-proof surface, outlasting the best lead and zinc paints by two to one.

Widely used for painting oil storage, Bitulumin is equally efficient on tanks, cars, metal buildings, refinery equipment, still towers, bridges, etc.

BITULUMIN, put up in double containers to insure fresh mixing, is made exclusively by Hill, Hubbell & Company, manufacturers of a special line of paints for the oil industry.

HILL, HUBBELL & COMPANY

Manufacturers of
Highest Grade Oil Industry Paints and Pipe Line Coatings
Fctories: SAN FRANCISCO and TULSA

Offices:
SAN FRANCISCO LOS ANGELES PORTLAND
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The Holmes-Manley *Cracking* Process

Flexibility of Operation.

High Yield of Quality Gasoline direct from the Unit.

Fractionation and Condensation under Full Operating Pressure.

High Yield of Liquid Products with a minimum yield of fixed gas and carbon.

Low yield of Residue Fuel Oil of good Quality.

Relatively low Operating Temperatures.

Ease of Control.

Long Runs and High percentage of Operating Time.

Low Labor and Fuel Costs.

Address Inquiries to

THE TEXAS COMPANY

W. S. S. RODGERS

17 Battery Place, New York, N. Y.

Branch Office

816 Palace Building, Tulsa, Okla.

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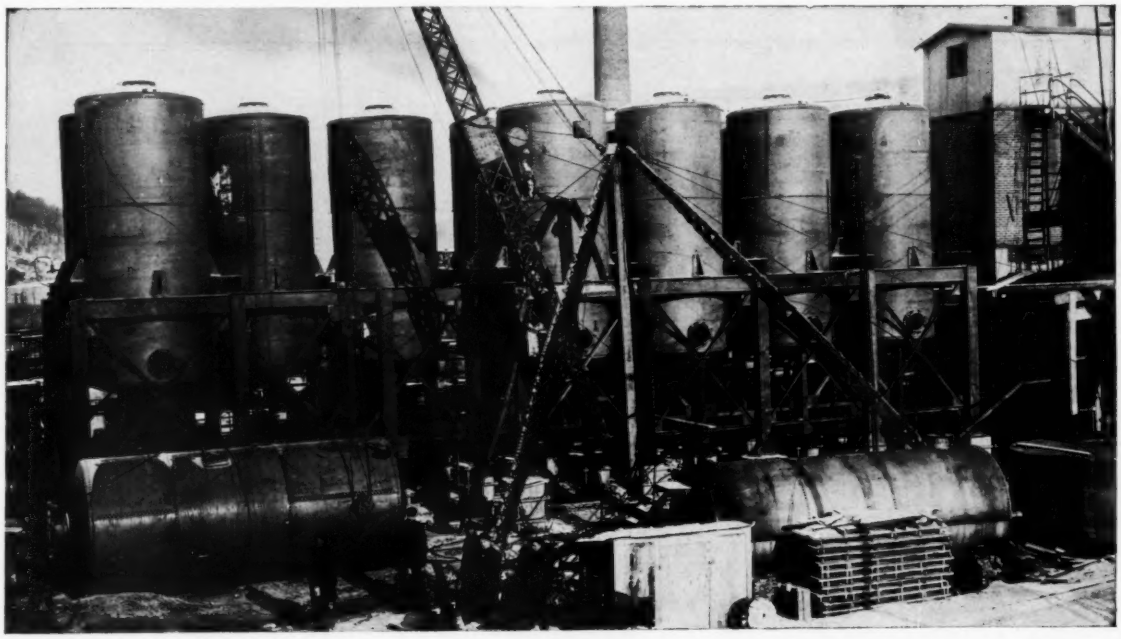


Hammond Filters with Fulton Patented Heads with Removable Non-Corrosive Monel Metal Screen. A Labor Saver doing away with old fashioned methods. Made in Diameters 5 to 10 feet and heights 10 x 30 feet. Names of users on request.

Our Bulletin No. 300 describes these Filters.

Our Bulletin No. 200 covers storage tanks from 300 to 80,000 barrels, and Bulletin No. 100R covers Horizontal Tanks from 1600 to 24,000 gallons. We make a specialty of furnishing steel tanks knocked down for domestic or export.

Erection men always available.

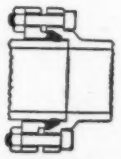
HAMMOND IRON WORKS

WARREN, PA.

Manufacturers and Exporters of Steel Tanks and Steel Plate Construction

(New York Office: 17 Battery Place—Telephone 0080)

SIMPLEX CAST IRON CONDENSER PIPING



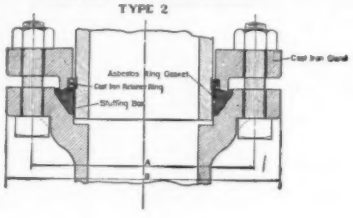
"ONE FLANGE IS LOOSE"

Settles the Rust Question

Progressive refineries now secure the durability of cast iron pipe in their condenser coils without the disadvantage of standard flanged pipe construction. Our Simplex joint, using a triangular shaped, endless asbestos gasket, is the secret. It is fully described and illustrated in our Catalog No. 55. Your copy is ready to be mailed upon receipt of your request.

Do you know why cast iron resists corrosion so much more than other ferrous metals? Our Bulletin No. 44 explains it.

CROSS SECTION OF ASSEMBLED JOINT
SIMPLEX CONDENSER PIPING
TYPE 2



Dimensions A and B are American Standard for 125 lbs. pressure

AREA PER LINEAR FOOT

SIZE	CLASS	INSIDE SQ.FT.	OUTSIDE SQ.FT.
3"	AB	.07854	.10125
3"	CD	"	.10472
4"	A	.10472	.13090
4"	B,C	"	.13195
6"	A	.15708	.18850
6"	B,C	"	.18850
8"	AB	.20944	.23600
8"	CD	"	.24460
10"	AB	.26200	.30100
10"	CD	"	.30960
12"	AB	.31416	.36600
12"	CD	"	.37460

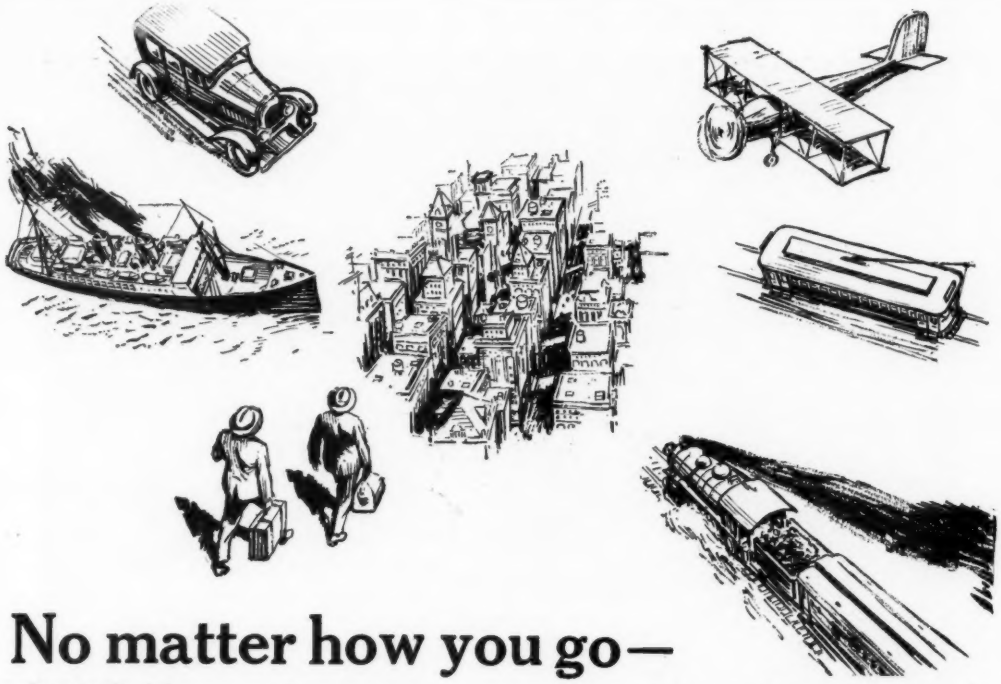
Write for Simplex Condenser Catalog Number 55

AMERICAN CAST IRON PIPE COMPANY

General Offices and Foundry: Birmingham, Ala.

Branches at
Dallas, Kansas City, San Francisco, Los Angeles, Chicago, New York,

Write Also for information on Our Prepared Joint Cast Iron Pipe for Oil Lines



No matter how you go—
STOP at cleaning economy headquarters!

CLEANING economy headquarters — Booths 61-62 in the Texas Building at the big Tulsa Exposition. That is where every producer, refiner and distributor interested in *better, safer* and *more economical* cleaning can obtain first hand information on the subject.

The 4th International Petroleum Exposition
OAKITE Booths 61-62
in the Texas Building
Tulsa, Sept. 24 to Oct. 1

What is more, you will see a real working demonstration of modern cleaning practices. For our Service Men will be there to show you how easily and rapidly oil, dirt and muck can be removed from salvage parts, tools and other equipment the OAKITE way.

Discuss with our Service Men your own particular cleaning — whether it's tank cars, storage tanks or motor trucks. There's an efficient OAKITE way of doing each job that will save you time, labor and money.

But, if you are unable to attend the Exposition, do the next best thing—write for a copy of our booklet, "Oakite in the Oil Industry." No obligation.

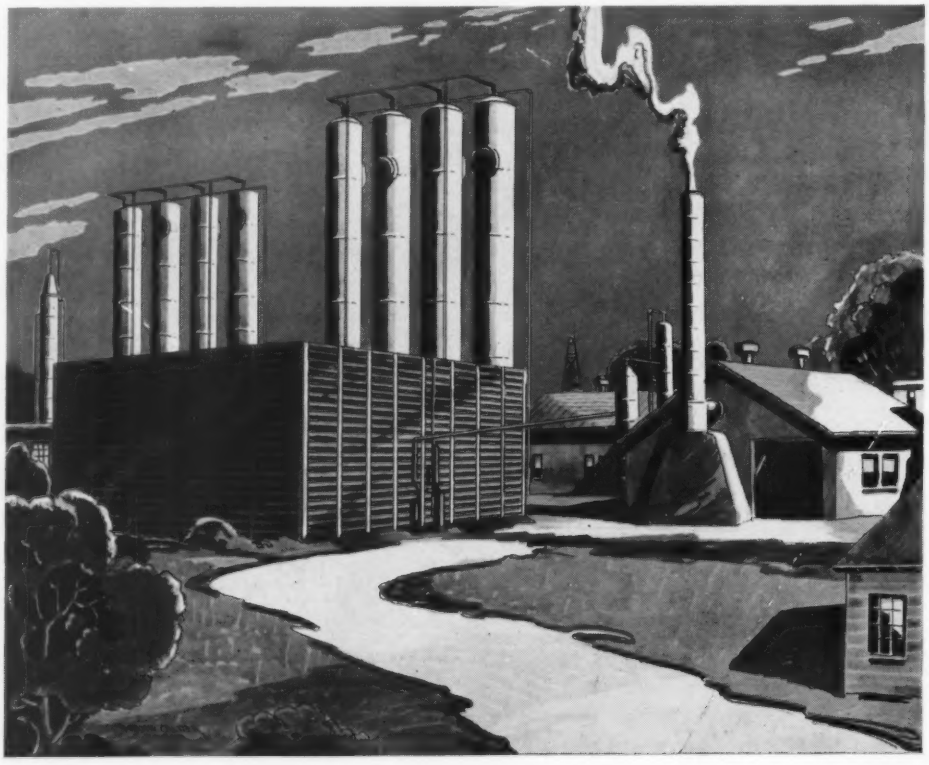
Oakite Service Men, cleaning specialists, are located in the leading industrial centers of the United States and Canada.

Oakite is manufactured only by
OAKITE PRODUCTS, INC., 50B Thames St., NEW YORK, N. Y. *(Formerly OAKLEY CHEMICAL CO.)*

OAKITE

TRADE MARK REG. U.S PAT. OFF.

Industrial Cleaning Materials and Methods



Ability to Absorb

The ability to take on unusual and unexpected jobs and turn them out in record time comes from good organization backed by the right facilities.

No amount of equipment will enable the weak organization to function properly when the unusual demand comes along.

And, no matter how strong and efficient an organization is, lack of good machines for doing the work will cause delay on getting out the job.

But where equipment and organization both are tuned to keep the pace, work to specification can be turned out as the demand arises.

Wyatt men, whether working in the shops at Dallas or putting in an installation at the customer's plant have the ability to perform. It is a trait of coming through which has been developed as a sort of inside morale of the Wyatt organization.

And Wyatt's, developing steadily with the Southwest and in touch with its leading industries, offers the facilities of a fully equipped and thoroughly adequate plant for the fabrication of steel and other metals.

Oil Tanks, Storage Tanks, Culverts, Smoke Stacks, Metal Products of all kinds. Refineries complete.

WYATT METAL & BOILER WORKS
DALLAS, TEXAS

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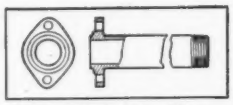
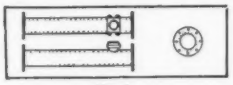
STERLING

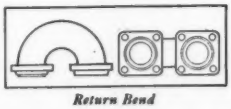
New and re-designed STERLING OIL PRODUCTS



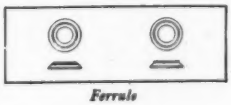
Companion Extension Pieces



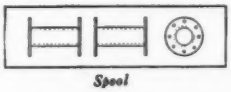
Header



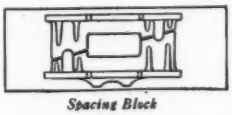
Return Bend



Ferrule



Spool

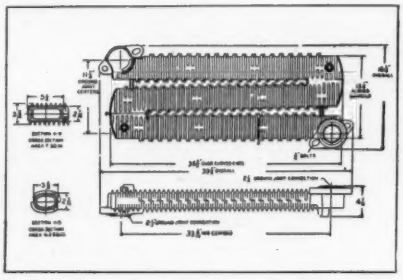


Spacing Block

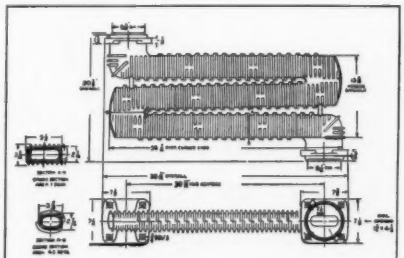
New Special Tank Flange for riveting to condenser box and connecting up to spool from condenser or cooling coil.

THE following new and re-designed STERLING Oil Products—made of corrosion-resisting ARCO Metal—and developed to meet changes in distillation practice necessitating higher pressures and temperatures—are of utmost importance to every refinery engineer in laying out new work.

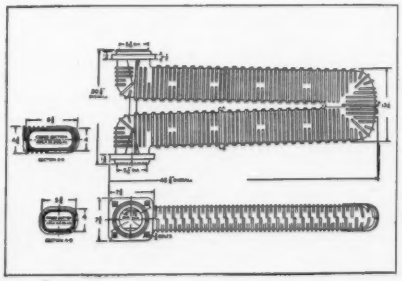
New 14 ft. Condensing Section, with Ground Joint Connection, including Ground Joint Flanges, Extension Pieces, Headers and Flanged Tees, also two new Headers—13⅛″ and 25″ in length.



New 14 ft. Cooling Section, tongue and groove, with 4-bolt connection, including Companion Flanges, Return Bends, Elbows and Spacing Blocks.



Re-designed Cooling Section, with 20 sq. ft of surface (formerly 19½ ft. Section), giving greater wrench clearance when assembling.



All these new products are in stock at our new foundry at Springfield, Illinois, ready for immediate shipment. ***Write for new detailed measurements before laying out new work.***

AMERICAN RADIATOR COMPANY

Industrial Division No. D

Factory: Springfield, Ill.

40 West 40th Street NEW YORK | 816 South Michigan Avenue CHICAGO | 935 Kennedy Bldg. TULSA | 1214 Quinby Bldg. LOS ANGELES

"UNITED"

EXHAUST PIPES AND PITS

MADE OF CAST IRON

WILL NOT CORRODE

The United Exhaust Pipe and Pit is of cast iron which affords longer life and the ability to resist acids, corrosion, and the higher temperatures in the gas.

PROTECTED FROM EXPLOSIONS

Explosion doors on the conical top of pit, are held closed by wood pins. Should an explosion occur, the wood pins easily break, thereby preventing any damage to the equipment.

EASY TO MOVE

Another feature is the ease with which United Exhaust Pipes and Pits can be moved from one location to another. Easy to disassemble, to transport and to erect economically at the new location.

CIRCULAR ON REQUEST

REFINERY EQUIPMENT

UNITED is an ideal source from which to obtain your new equipment, or repairs and replacements to your present refinery equipment.

A FEW OF THE PRODUCTS

Stills
Condensor Boxes
Vapor Towers
Heat Exchangers
Steel Tanks,
Etc., Etc., Etc.

QUICK SERVICE, TOO

United with its large fabricating plant located near the field on three direct railroads is in a position to make prompt shipment of all types of steel refinery equipment. A trial, we are sure, will convince.

NOW SERVING MANY LARGE REFINERS

Many of the larger refineries throughout the country are using United steel refining equipment. Over 25 years of experience insures its efficiency and dependability over a long period of time.

CATALOG ON REQUEST

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SALES OFFICES:

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DALLAS, TEXAS
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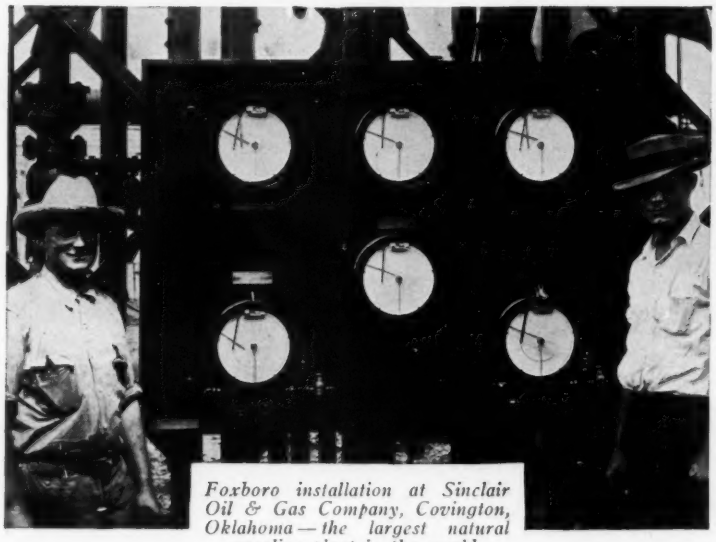

Foxboro installation at Sinclair Oil & Gas Company, Covington, Oklahoma — the largest natural gasoline plant in the world.

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They are air-operated, can be set directly to the control point, and are positive and simple in action. Just set the control arm and the temperature is automatically held at the exact degree without juggling or manipulation.

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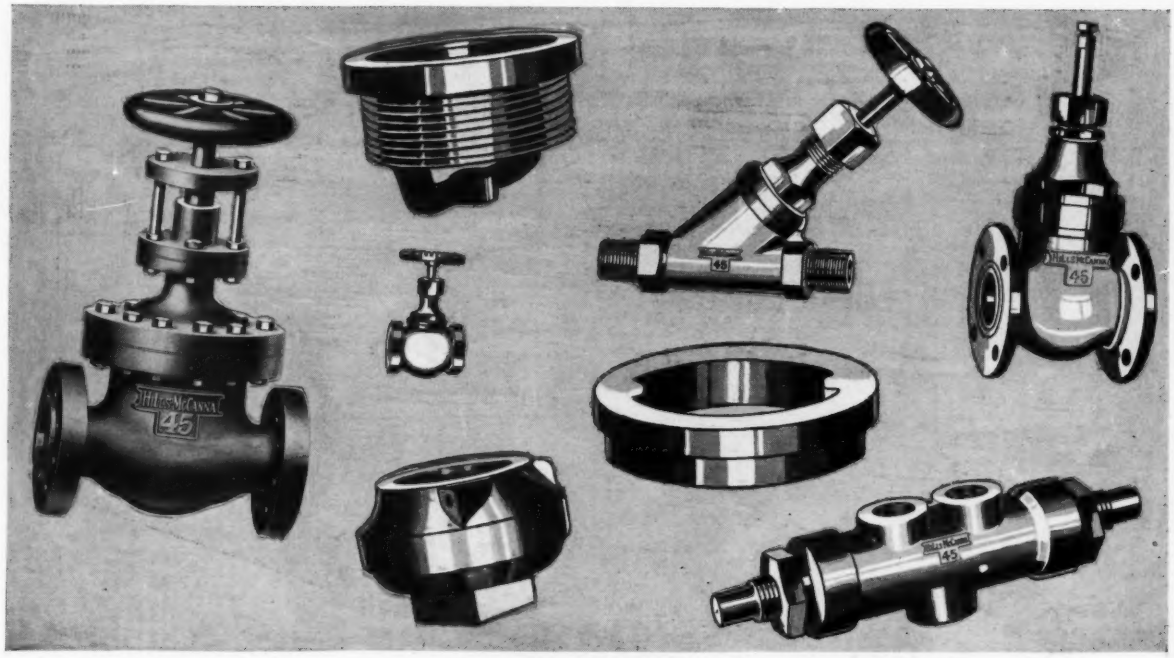

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Vol. 6, No. 9

SEPTEMBER, 1927

The REFINER

AND NATURAL GASOLINE MANUFACTURER

Edited Monthly at Tulsa, Oklahoma

GRADY TRIPLETT, *Editor* GEORGE REID, *Associate Editor*

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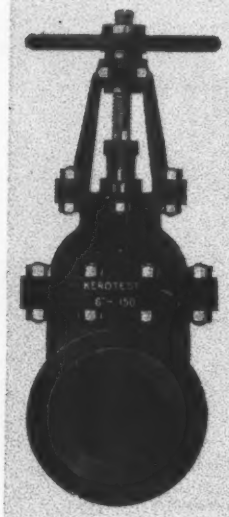

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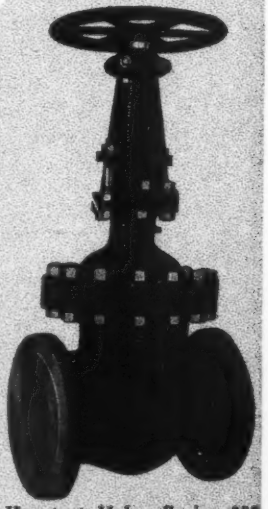

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Fractionation Supersedes Distillation

SINCE the early "teens" the refining industry has been in the stage of transition, developing step by step, progressing by easy stages, from the rule-of-thumb methods of old line refiners, and every year coming closer to that perfection of plant operation which can only be attained by the understanding and application of scientific law.

Like the metamorphic change from caterpillar to butterfly, the refining plant has experienced its transformation from the flat bottomed cheese-box distillation unit, attended by its frequent re-distillation procedure, to the single heating, one operation process now prevalent through the employment of the modern tubular retort, with no re-distillation. From an industry dependent upon re-evaporation and re-condensation,—a costly procedure,—for the purification of its products; petroleum refining in the easy stages of its scientific development is rapidly forging ahead to the end that distillation becomes of minor importance and fractionation with accurate control is the paramount factor indicative of plant efficiencies.

Fractionation, favorably comparable to the high degree of perfection and efficiency long secured in the alcohol and allied industries, has been attained by petroleum refiners. During a period of 10 to 15 years the refiner has progressed from his cheese box or shell still distillation and redistillation, through the period of "tower per still" procedure to the present design of equipment consisting of tube still and multiple-stream fractionating column, with, in most instances, the elimination of redistillation or "re-running." Compare for example, the 5000 barrel unit of today, requiring but a few square yards of ground, with a plant of former years of like capacity with its extensive battery of first run stills, and its auxiliary battery of re-run stills, and a striking picture of progress in oil refining is the result.

The advent of the cracking unit, bringing with it the perfection of accurate control devices, has done more to influence the efficiency of the modern skimming plant than any one other factor.

Old line refiners, in fact, were often antagonistic to scientific operation.

With the cracking unit brought to their refinery yards, the smoothness of their operation through the element of accurate control of heat, pressure, velocities,—fire, draft, furnace and stack,—and many other factors in conjunction with the efficient operation of such equipment, the refiner through his contact with high pressure installations was soon impressed with the value of accuracy of control.

Paralleling the adoption of cracking equipment among refineries came the extensive use of the tube stills. The cracking unit is a pipe still.

In how many refinery yards have large efficient tubular retorts with their conjunctive equipment, the multiple-stream fractionating column, followed soon upon the heels of the first cracking unit?

And next? The refinery would consist of a combined unit—a unit which receives the charge of crude oil and skims from it the gasoline and perhaps, the kerosene—then cracks the gas oil fraction into still more gasoline, or the residuum—and yields each of these various products exactly fractionated to predetermined specifications; all in one operation.

The modren progressive refiner feels, and justly so, that distillation is a mastered subject; a great deal is common knowledge concerning fractionation and close separation of special, valuable, close-cuts, secured simultaneously with large recoveries of gasoline and other distillates is becoming common practice. With closer attention and precise application of the physical laws governing vapors and gases will come greater efficiency and better economy of operation.

The fire box, the furnace, the boiler house, long misused through lack of understanding is attracting the attention of the combustion engineer and the technologist, the chemist and the physicist, essentially interested in their respective works, are, through the cooperative efforts of company heads, perfecting with their fellows, instruments and devices, processes and methods, virtually automatic, labor saving and safe,—and the industry, forgetting its traditions of practical operation is speedily entering into the final stage of its development with its scientific plants scientifically operated. Gone are the days of "rule-of-thumb." The so-called practical man, with nothing but practice to guide him, finds the industry becoming technical. The technical man of a few years ago, with nothing but practical experience to assist him, is, nevertheless, responsible for the scientific development of the industry,—and is the practical, technical refinery executive of tomorrow.

And instead of intricacy, complexity, and a confusing tangle of equipment, the refinery of today,—and the refinery of tomorrow, will have as its keynote,—simplicity, and easy, economical operation.

Looking Down a Long Row of Whirling Coopers

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This is another reason why so many companies are turning to Coopers and also why once they use them they seldom change.

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Exposition to Depict Refining Progress

Aviation and its relation to natural gasoline to be part of events in Tulsa, September 24 to October 1

By GRADY TRIPLETT

TULSA—While the spectacular features of petroleum refining are no match for the romantic phase of producing oil, the Fourth International Petroleum Exposition, September 24 to October 1, will offer perhaps the foremost opportunity students ever have had to learn of the progress in the manufacturing division of the industry.

Considerable of the space of the scientific building will be devoted to methods of refining crude oil and the manufacture of natural gasoline. Of equal if not greater opportunity to the student of this part of the industry will be the exhibits of the equipment, essential to modern refining and natural gasoline manufacture.

Progress in refining practice is written in the equipment essential to improved methods. This equipment, the output of scores of plants, will be on display. From it and from the displays in the scientific building, the student of refining practice will have his opportunity to measure the trend of manufacture in the petroleum industry.

To Stress Aviation

Exhibits also will include the finished products of several of the leading refiners of the United States.

Of direct interest to the natural gasoline industry will be the place aviation will play in the exposition. Recently natural gasoline, made by special process, has come into prominence as an airplane fuel. The Fourth International Petroleum Exposition will bring the science of aviation and the petroleum industry into closer touch than ever before.

The outstanding event in aviation will be the visit of Colonel Charles Lindbergh. He is to spend one day, either September 30 or October 1, in Tulsa, and the exposition will be the center of his activities.

His visit will give the men of the oil industry opportunity to display what they are doing in the use of air transportation in their own affairs and the willingness with which they are contributing to the development of aviation.

Next to the Lindbergh visit, aviation will be represented in the presence of the Stanolind, owned by the Standard Oil Company (Indiana.) It will bring Colonel Robert W. Stewart, chairman of the board; Allan Jackson, vice president in charge of sales; R. H. McElroy, vice-president in charge of traffic; E. J. Bullock, vice-president in charge of purchases, and one or two other officials.

Safety Competition

The Texas Company will have a plane from Houston. Another will be sent by the Phillips Petroleum Company of Bartlesville. Many other privately owned planes will be present.

The Fourth International Petroleum Exposition gives every evidence of surpassing records of previous expositions. Space sold for exhibits is greater than at previous expositions. The buildings have been moved to larger grounds, farther removed from the city. The larger space will give opportunity for better handling of crowds.

Gates will be opened when President Coolidge presses a button at Washington. The opening will follow appropriate preliminary events in Tulsa. Thereafter and until the exposition closes the following Saturday night, events will follow in rapid order.

Of special interest to the manufacturing branch of the industry will be the safety contests. Teams representing the refineries and natural gasoline plants of the Mid-Continent will compete with teams representing producing concerns for a prize. All this will be under the Safety Division of the Mid-Continent Oil & Gas Association.

Golf Tournament

Due to the presence of many golf players within the oil fraternity a tournament will be staged. This will be palyed on the Tulsa Country Club course, beginning September 26. The qualifying rounds will be for 18 holes. After this, entrants will be divided into flights of 16 each for match play. Prizes will be awarded both winner and runner-up in each flight and also to the qualifying medalist. The J. Edgar Pew trophy will go to the State whose players have the lowest medal scores.

Diplomatic representatives of the foreign countries having oil production have been invited to attend the exposition. Aside from these foreign oil producing and refining concerns are to have men here. These foreign delegations are expected to surpass in numbers those of previous expositions.

Three state governors are to attend the exposition. Governor Johnston of Oklahoma, Governor Paulen of Kansas and Governor Adams of Colorado have accepted invitations from the management.

Low rates granted by the railroads assure attendance from the whole oil producing and refining territory. Special delegations will come from St. Louis, Dallas, Beaumont, Ranger, San Angelo and from Guthrie and other cities in Oklahoma.

In close relation to the exposition will be the annual meeting and banquet of the Mid-Continent Oil & Gas Association, September 30. The banquet will bring speakers of national reputation to Tulsa.

E. W. Clark, president of the American Petroleum Institute, will attend the exposition.

Transportation Better

Although the site for the exposition has been moved farther from the business section of the city, transportation is better than formerly. Three thoroughfares, several improved roads, street railway and bus lines will serve the fair.

W. G. Skelly, president of the Skelly Oil Company, is president of the exposition. Alf G. Heggem, president of the Oil Well Improvements Company, is vice president, as is Frank Hinderliter, president of the Hinderliter Tool Company. William Holden, secretary of the Tulsa Chamber of Commerce, is secretary. James J. McGraw, president of the Exchange National Bank, is treasurer, and P. D. Hayes, assistant cashier of that bank, is assistant treasurer.

J. Burr Gibbons of Tulsa has managed the exposition this year.

Directors of the exposition are A. F. Bourne, secretary-treasurer of the Oklahoma Iron Works; W. M. Bovaird, secretary-treasurer of the Bovaird Supply Company; A. W. Leonard, vice president of the Devonian Oil Company; O. C. Staples, Frick-Reid Supply Company; D. D. Wertzberger, Wertzberger Derrick Company; Fred W. Insull, Public Service Company of Oklahoma; R. C. Sharp, Oklahoma Natural Gas Corporation; R. B. Pringle, Independent Oil & Gas Company; J. S. Sidwell, Prairie Oil & Gas Company; John M. Lovejoy, Amerada Petroleum Corporation; H. N. Cole, Pure Oil Company; Clyde Papé, Shelby Oil & Gas Company; Jacob France, Mid-Continent Petroleum Corporation; Clyde Alexander, Phillips Petroleum Company; Walter Miller, Marland Refining Company; Ernest Nicklos, The Texas Company; A. A. Beard, Tidal Oil Company; C. P. Dimit, Gypsy Oil Company; Victor H. Smith, North American Car Corporation; H. V. Foster, Indian Territory Illuminating Oil Company; J. M. Hayner, Hayner-Reeves Company; G. A. Dye, H. F. Wilcox Oil & Gas Company; R. F. Garland, Walter Gray, Jarecki Manufacturing Company; Robert W. Eagan, the Oil & Gas Journal; J. M. Post, Oil Well Supply Company; Warren C. Platt, National Petroleum News; R. L. Dudley, Gulf Publishing Company; Waite Phillips, the Philmac Company; J. Edgar Pew, Sun Company; R. A. Griffith, Sinclair Oil & Gas Company.

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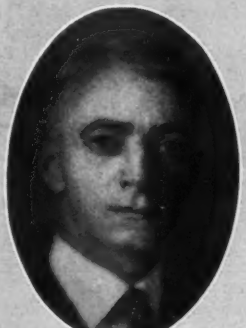
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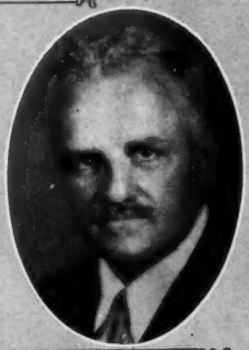
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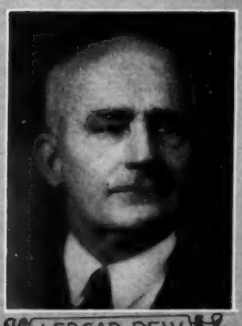

J. EDGAR PEW

N. P. A. History Unfolded for Anniversary Meeting

Fayette B. Dow, counsel of the organization traces development of body

TRACING the history of the organization and development of the National Petroleum Association, and recalling the valuable activities of the organization and its departments over the 25 years since its inception, Fayette B. Dow, general counsel, opens his volume with the statement that the history of the National Petroleum Association is the story of the beginnings of successful co-operation in the oil industry. The history was prepared for the twenty-fifth anniversary meeting, Atlantic City, September 14, 15 and 16.

At Pittsburgh, July 17, 1902, at a meeting of the Independent Oil Refiners of Pennsylvania and Ohio, upon adoption of a motion "that an association be formed to promote the independent oil industry," the National Petroleum Association was formed and 19 companies enrolled as founders of the new organization. Of these founders Mr. Dow says "of the original 19 members, 15 are still in business and are active members of the association." Of the other four it is explained that by mergers, sales, etc., they are not actually lost to the present association with its membership many times the number originally represented.

The early history of the association, the various discussions among members, the early problems taken up by the group dealing with such matters, the incorporation of the association, export business, insurance, freight rates, tank car specifications, related in the volume by Mr. Dow becomes one of the most interesting treatments of the association history available, for it was during these times that the secret methods of the early refining business were in the transitory stage; just entering into the co-operative activities of the refinery industry.

Incorporated in 1907

The National Petroleum Association was incorporated during the fall of 1907. The organization meeting at which the charter was formally accepted, by-laws approved and ordered filed, and a corporate seal adopted, was held in Pittsburgh, January 20, 1908. A certificate of incorporation, under the laws of Pennsylvania, was executed in September, 1907, and this certificate states that:

"The purpose for which this association is formed is to foster, protect and promote the welfare and interests of persons engaged in the refining of petroleum and its products, and for the protection and encouragement of that business and commerce, by combining the intelligence and influence of members against imposition and fraud, as experience may, from time to time, prove needful, by bringing about greater uniformity and certainty in business connections by establishing closer lines of business association among the members."

In his discussion of the formation of the mutual fire insurance organization which has played an important part in the matter of reduced rates and in this manner made important savings to its members, Mr. Dow says in part:

"At a meeting in February, 1908, Mr. Willock introduced a man experienced in mutual insurance in another industry, to address the members on this subject. In October of that year the propasal was again discussed and the committee was directed to proceed with the organization of a mutual fire insurance company under the laws of Pennsylvania, subject to the approval of the trustees. The National Petroleum Mutual Fire Insurance Company was chartered in 1909 by that State. At the semi-annual meeting in March the committee presented Houston Dunn to explain the advantages of mutual insurance. The recording secretary wrote that Mr. Dunn made a very favorable impression, particularly as to the need of plant inspection. He was engaged to operate the newly formed company and is today in active charge of its management. At the annual meeting in that year, 'a large number of members present made application for insurance.'

O. P. KEENEY
President, 1924-27 *Trustee*, 1919-27

"Starting in January, 1910, with 23 members, the growth of this co-operative enterprise is indicative of the substantial service it has performed for the petroleum industry. In 1910 the lowest rate in effect for any refinery was $3.50. The National Petroleum Mutual wrote its first policies at 10 per cent less than the prevailing rate. At the close of 1911 the company had 115 members and the average rate had fallen to $2.45. The average rate on properties of present members of the association does not exceed $1.10 and with its service extended to marketers, the membership of the National Petroleum Fire Insurance Company at present is 650. While making due allowance for the effect of improvements in the physical condition of properties, the competition of this mutual company has undoubtedly been a very great factor in reducing fire insurance rates. The savings which it has brought about for the industry cannot be definitely stated, but they run into millions of dollars. It was the first to issue policy forms which adequately cover the requirements of the industry. It has paid nearly two millions of dollars in fire losses to the industry and is today in stronger financial position than at any time in its history. Many of the men prominently identified with the association, among them V. B. Ward, the first president of the company; Harry H. Willock, W. H. Fehsenfeld, J. I. Lamprecht, Charles L. Suhr and W. E. Wall, have been active in its management. At present its president is E. M. Lyons, a trustee of the association.

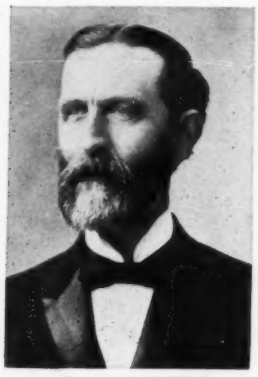
Departments Provided

"The success of the National Petroleum Mutual is due in largest measure to Houston Dunn. A fire protection engineer by profession when he became associated with it, Mr. Dunn has made an intensive study of fire hazards in the oil industry. Through his investigations into the causes of fires the company has made recommendations of great importance in safeguarding against them. These recommendations have been frequently made at association meetings where Mr. Dunn has spoken with characteristic frankness. Well informed in the technical aspects of insurance, he has managed the company with commendable prudence and unquestioned integrity."

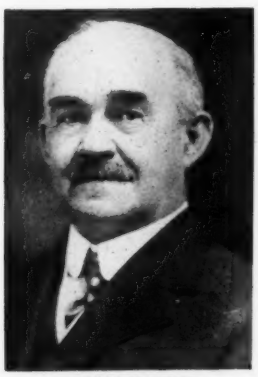
There follows the history of the co-operative efforts of the association throughout the years following, all of which is of much interest, but cannot, because of lack of space be included in this

FOUNDERS OF THE NATIONAL PETROLEUM ASSOCIATION

HERBERT G. EATON
Secretary of organization meeting, June 17, 1902
Recording Secretary, 1903-1927
Trustee, 1907-1908



H. A. JAMIESON
President, 1902-1903
Honorary President, 1903-1904



WILLIAM MUIR
President, 1912-1917
First vice-president, 1911-1912
Trustee, 1911-1912
Honorary Member

W. E. WALL
President, 1903-1912
First vice-president, 1902-1903
Trustee, 1907-1919; 1920-1921
Honorary Member

report. In 1919 the association's eight departments were created, which were:

"1. Manufacture. 2. Standards and Tests. 3. Traffic and Transportation. 4. Legislation and Litigation. 5. Membership and Relations. 6. Economics, Accounting and statistics. 7. Welfare and Insurance. 8. Trade and Commerce.

"This outline of the association's history in the past is not intended merely as a look backward over the experiences of 25 years. The association is proud of its clean and creditable past, but it is a living organization, vigorous and active in sound lines of endeavor, conscious of doing a useful work and approaching the future with confidence. There is a place, then, in this volume for a brief summary of what its departments are doing today.

"Before referring in detail to the present work of any of the departments of the association, a word should be said about a plan which has been invoked to some degree in all of them. This is action by groups. The refineries of member companies are located for the most part in well defined geographical centers. It is the aim of the association that designated representatives of each refinery in these centers shall be active in the work of each department. The organization of these men into local groups affords an opportunity, with minimum expenditure of time and money, for the discussion of the particular problem on which they are working, for the exchange and information and for concentration of effort. Notable advance has been made in this direction and substantially greater progress will be made as the principle of group action continues to justify itself in definite results until it becomes a fixed habit of work in the association. As the habits of group activity are formed advances in the course of co-operative endeavor will be made with increasing ease, enjoyment and effectiveness.

Manufacture

"Two men have one dollar each. They exchange these dollars. Each man has one dollar.

"Two men have one idea each. They exchange ideas. Each man has two ideas."

"There is perhaps no activity of the association which better illustrates the changes of thought and attitude of the members of the association toward each other that have taken place in the years since it was organized, than the work of the department of manufacture. The founders were quite willing to unite against a common enemy, against abuses of power and privilege in high places but, of course, that enemy was outside their ranks and those abuses were not of their own making. When it came to matters within the confines of their own plants, that was the business of each refiner and of no one else. What if that common enemy were inefficiency, or waste or the withered hand of obsolescence? Well, if there were such an enemy it was not so recognized, at least in the refiner's own opinion. Each refiner's plant was best. Each had some exclusive knowledge which gave him an advantage and that advantage he would keep. His gates were shut. 'Will you join me to fight the enemy?' 'Certainly I will, but keep out of my plant.' These men now recognize that what they thought was exclusive knowledge was common knowledge—if indeed it was knowledge at all.

"With the disappearance of rebates, discriminations, predatory practices, came equal opportunity. Opportunity for what? Opportunity to survive in a competition that was keener than before, competition backed by large capital, producing quan-

FAYETTE B. DOW
General Counsel, 1926
Washington Counsel, 1918-1926

C. D. CHAMBERLIN
Secretary, 1906-1927
General Counsel, 1917-1926
Advisory Counsel, 1926

SAMUEL MESSER
President, 1917-1919
Second vice-president, 1914-1915
Treasurer, 1920-1921
Trustee, 1912-1921

U. G. LYONS
President, 1919-1924
Trustee, 1919-1924

tity output, developing through research rapid and costly improvements in refining methods. In this situation is inefficiency or waste or obsolescence a common enemy?

"The answer of a large number of members to that question is found in their participation in the work of the department of manufacture. The old attitude is changing. Witness the refinery visits which have been held under the auspices of the department. Modern up-to-date plants thrown open to inspection. 'If we have developed something in which you are interested, gentlemen, come in and see it. There will be conveyances ready for you at the station and at noon lunch will be served at the plant.' There is a growing feeling that closing the gates of the refinery will shut out more information than it shuts in.

"The department is promoting study by groups on problems which offer possibility of economies and betterment. The results are put in writing and the papers are read at association meetings. Viewed in the light of what is possible the department feels that only a beginning has been made. There are limits of time that can be given to additional duties, and other handicaps. But there are few, if any, who doubt that this work is sound and constructive. Its future development along useful lines seems certain.

"It has produced an interesting by-product. For a considerable time only the executives of member companies attended association meetings. The work of the association was done by its employed staff and their reports formed a large part of the program. But the several departments, in the development of their group activities, have reached into the company organizations for their well-trained, talented younger men. These men have come to the meetings, occupied important places on the programs and their contributions to the interest and enjoyment of the meetings have been very substantial.

"During the last two years the department of manufacture has undertaken a program of co-operative engineering, participated in by from 15 to 20 member companies. A very competent combustion engineer was employed to bring about boiler room economies. Analyses of existing performance were made, changes in practice instituted, tests run to show fuel consumption under these changes, followed by inspections intended to keep performance up to the standard of efficiency indicated. In the second year, this work was continued and also extended to a further study of the steam systems to effect economies in the use of steam after it leaves the boilers, and of combustion efficiencies in connection with the operation of stills.

"The trustee in charge of this department discussed the results of the work during the first year at the annual meeting in 1926. 'Like every new venture,' he said, 'no matter how carefully planned, mistakes were made and some dissatisfaction by a few of the subscribers was evidenced. However, the chart which has been prepared, and to which I shall refer in my remarks at the meeting, shows whether or not the trustees were justified in proposing their plan. Summarized, this chart shows, for the 19 refineries an estimated total yearly saving by proper firing, with present equipment, of $154,940; an annual average saving per refinery of $8150. The total boiler house power was 14,400 and the estimated average saving per boiler house power, $10.76. The minimum saving for one refinery is 10 per cent of the fuel and the maximum 48 per cent.

"Our engineers also made recommenda-

(Continued on page 110).

Gulf Publishing Company Announces New Building

BELOW is a perspective of the new home of the Gulf Publishing Company now under construction.

This building will house on the second floor, the editorial, circulation, advertising and business offices of the company, which owns and publishes *The Refiner and Natural Gasoline Manufacturer, The Oil Weekly* and *The Petroleum Marketer.* The printing plant in which these journals are printed, and in which petroleum books printed by the company, are handled, will be on the ground floor.

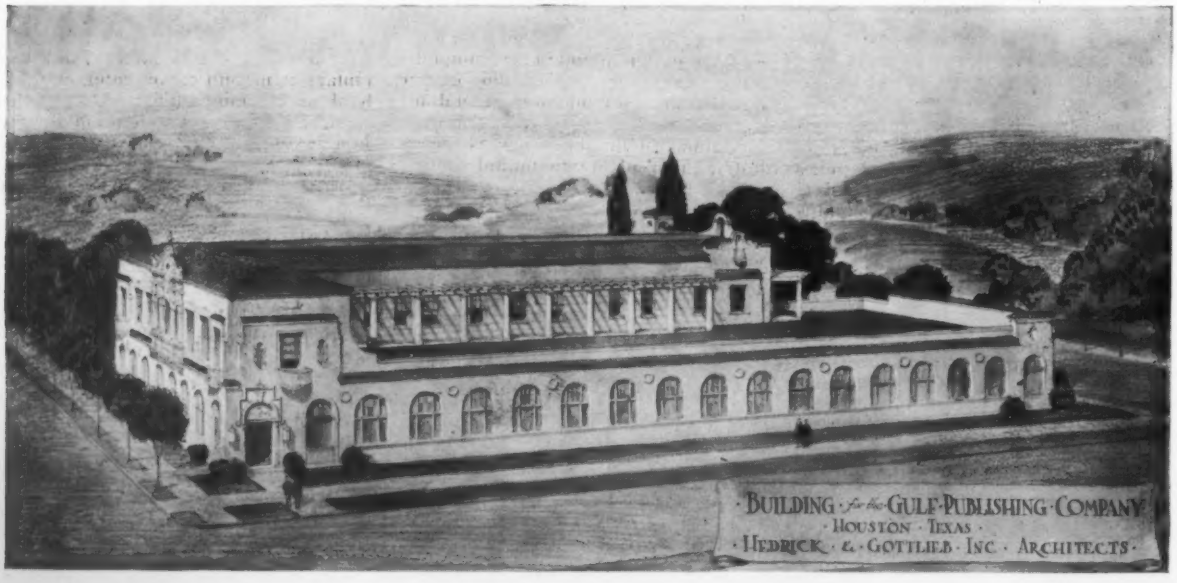
Built of reinforced concrete, and tile throughout, the structure will be absolutely fireproof. The building pictured below will be the first unit of a series of buildings which will eventually cover the entire block owned by the company on Buffalo Drive, one of Houston's scenic boulevards. It will be 166 by 70 feet, two stories in height.

Construction will start within a few days.

It will be located on a slight elevation, on a curve of the drive, about two miles from the center of the business section, but, due to the fact that there are but two street intersections between the plant site and the down town section, it is only a four and a half minutes drive from the heart of town by automobile.

The block on which it is located has 467 feet frontage on the drive, and is faced by a city-owned parkway, which extends from the downtown section along Buffalo Bayou to the River Oaks Country Club.

In designing the structure, the architects have used the Spanish type in its entirety.



Accomplishments of Association Are Reviewed at Anniversary Meeting

National Petroleum Association members will co-operate on accident prevention following success in handling fire problem

By GEORGE REID
Associate Editor

ATLANTIC CITY, N. J.—In his opening address before the first session of the twenty-fifth anniversary meeting of the National Petroleum Association, which opened a three-day session here September 14, O. P. Keeney, retiring president of the association, stressed the importance of co-operative effort among association members and reviewed briefly the history of the association's activities and accomplishments since its inception in 1902. Mr. Keeney complimented the past success of the pioneer among petroleum associations, but hesitated to make any prophetic remarks as to the future, suggesting, however, that if the group of refiners who are members of the National Petroleum Association are as successful in the future in their efforts toward advancement of the industry in all its phases and departments, it would be well to call together another anniversary convention in 10 years from this date and review work done during that period, as is being done at this convention after 25 years of gratifying activity and work.

Sessions of the convention Thursday and Friday were given over to reports of the various trustees of the departments of the association and to the reading of papers prepared by members and others dealing with the business, engineering and scientific efforts of the association.

Dr. T. C. Eldridge, Atlantic Refining Company, read an especially valuable and well written and interestingly delivered paper with the title of "New developments in Petroleum Manufacture." The article provoked much comment and later discussion. The paper is presented elsewhere in this issue.

A. W. Scott, trustee in charge of the Department of Standards and Tests, reported the progress of the past year's work to the association and emphasized the benefits accruing to the 35 chemists from member companies who enjoyed a one-day visit to the Washington offices of the Bureau.

This department plans subsequent visits to the bureau offices, since past experience has shown that the refinery chemists are vitally interested in the work of the bureau. The full day's program followed at such meetings is of much value to the laboratory men making the trip.

Accident Prevention

H. N. Blakeslee, field representative, Petroleum Division, National Safety Council, delivered a talk dealing with accident prevention and first aid work. This paper is also published in this issue.

After this talk, the association in general session decided that its trustees should investigate the advisability of having its fire marshal's association also take up the work of accident prevention and safety in conjunction with the present activities of this organization. The association decided to continue the work of the fire marshal's association throughout the coming year after the report of this department's highly gratifying record of its past year's endeavors. Fire marshals' groups to make weekly inspection trips through the various refineries have been organized at Warren, Bradford, Oil City, and Titusville, Pennsylvania. Present plans call for the continuation of the group inspection policy throughout other refining districts where member companies are engaged in refinery operation.

Values of Association

At this, its silver anniversary, the association takes much pride in the vast amount of beneficial work done throughout the 25 years of its life. Working through its eight departments, which policy secures wholehearted co-operation in the form of member activity, the National Petroleum Association has become a valuable asset to the petroleum industry. Numbered among its accomplishments are such results as reduced operation costs of its member refineries, improved trade conditions, beneficial results in matters pertaining to traffic and rates, the solution of numerous troublesome tax and legal problems, the gathering and better interpretation of trade statistics, reduction of fire hazards and losses, improved general and cost accounting methods, improvement in the attitude of the public toward the industry, legitimate efforts toward elimination of unfair or discriminatory legislation, the exchange of ideas, helpful inter-laboratory conferences with resulting uniformity of testing methods, and the establishment of specifications, interchange of credit information, welfare work for employes and accident prevention, all through the co-operative efforts of the personnel of the association's 54 member organizations.

Officers Named

New officers for the coming year include: E. M. Lyons, Tiona Refining Company, president; P. S. Tarbox, Independent Refining Company, first vice president; H. A. Logan, United Refining Company, second vice president; Fayette B. Dow, Washington, general counsel; C. D. Chamberlain, advisory counsel; Willis Crane, traffic attorney; Herbert G. Eaton, recording secretary, and G. B. Hunter, treasurer.

The new board of trustees includes H. H. Greene, Kendall Refining Company; Fred G. Clark, of Fred G. Clark Company; Sheldon Clark, Sinclair Refining Company; Frank B. Fretter, National Refining Company; H. A. Logan, United Refining Company; E. M. Lyons, Tiona Refining Company; T. J. Hilliard, Waverly Oil Works; O. P. Keeney, Tidewater Oil Company; A. W. Scott, Empire Oil Company; P. S. Tarbox, Independent Refining Company; R. A. Wotowich, Empire Refineries, and C. C. Davidson, Tri-State Refining Company.

In his opening address at the beginning of the convention, O. P. Keeney stressed the importance of co-operative effort among association members. He reviewed briefly the history of the association activities and accomplishments since its inception in 1902.

On the second day of the convention, Edward Prizer, chairman of the board of the Vacuum Oil Company, read a paper on foreign observations.

Mr. Prizer's observations covered social conditions in the different nations he visited on a recent trip around the world. He sees in the suppressed Oriental nations a growing national feeling which is bound to mean advancement. Poverty is the only barrier to improvement in their living conditions.

The Oriental, as Mr. Prizer concludes from his travels is as eager to take advantage of modern conveniences, especially those of transportation, as people in our own country, but widespread poverty is a serious handicap in the Far East.

He says, "The automobile more than any other single present-day invention is bringing about a change in the habits and outlook of the peoples of the whole world. The day of rapid transit has arrived as a universal proposition, and there is no more reason to expect any less serious hold upon Oriental peoples than peoples elsewhere. There is every just cause to anticipate, as time goes on, that the flow of petroleum products to the Far East will greatly increase."

More than 200 members and their wives attended the silver anniversary banquet at the Hotel Tremaine, Thursday night. The banqueters were entertained by the Cross quartet of radio station WJZ, New York. Doctor Catell of Philadelphia also addressed the gathering.

Control of Equilibrium Important Phase in Snelling Process

Latest patent considered an outstanding contribution to the refining of petroleum

APRIL 12, 1927, there was issued to Walter O. Snelling of Allentown, Pa., one of the most important patents relating to the art of "cracking" that has as yet been issued, namely, Patent No. 1,624,848. This patent has been assigned to the Gasoline Products Company, Inc., of New York City, N. Y. (Cross interests.) The record date for the disclosure is the filing date of the application Serial No. 26,110, fiiled May 5, 1915. The application was renewed October 17, 1922, then carrying Serial No. 595,167.

The invention relates to the *treatment of oils under heat and pressure* and hence constitutes another of the so-called "cracking patents." More specifically, the invention comprises "a process of treating petroleum oils wherein a body of petroleum material of any nature is heated to a high temperature until a condition of *equilibrium* among and between the various hydrocarbons therein is established and wherein fresh petroleum material is supplied to said body more or less continuously and at a rate insufficient to disturb substantially the equilibrium relations in said body, one or more of the products of the equilibrium being withdrawn in a similar manner . . ."

In effect, this means that a pool or a body of high boiling oils, such as crude oil, gas oil, etc., is heated in a roomy chamber (the capacity of which is more than twice the volume of oil—calculated on the volume of cold oil—maintained within said chamber) until an equilibrium is established between the liquids, vapors and gases within the chamber. After this equilibrium has been established, and during maintenance of same, fresh oil is fed into the chamber, while at the same time there is withdrawn in the liquid state one or more of the products of equilibrium. For example, there would be withdrawn continuously gasoline or kerosene or both or "equilibrized oil," during which period of withdrawal fresh oil would be fed into the chamber—both steps being carried out at such a rate as not to disturb, materially, the prevailing equilibrium within the chamber.

Temperatures and Pressures

The temperatures and pressures required in order to produce the desired condition of equilibrium, mentioned by Snelling, are of interest.

In the specifications of his patent, Snelling states:

"To produce the equilibrium; in the case of a heavy oil, I find that a *momentary* heating, so that a gauge pressure of 800 *pounds* is produced, suffices. The same results are obtained more slowly by heating to a gauge pressure of 660 *pounds*. Where light oils or gases are treated, the gauge pressure maintained can not, of course, be relied upon, but I find in this case that heating to a temperature of 400 degrees to 600 degrees C. (752 degrees to 1112 degrees F.), produces the same result. That is, equilibrium is obtained either at an 800-pound pressure (which corresponds to 400 degrees or 500 degrees C.—752 degrees or 932 degrees F.—in the case of heavy oil), or a temperature of 500 degrees C (932 degrees F.) with any oil. Where it can be used, the gauge pressure is the most convenient index. Gauge pressures up to 2000 pounds have been obtained, but the action is not substantially different from that obtained at 800 pounds."

Snelling found further, it is worth noting, that the pressures and temperatures required for the equilibrium could be lowered by using a catalyst in the oil, for, he says:

"The pressures and temperatures required for the equilibrium are, as seen, rather high, but I find that the same results can be obtained at lower temperatures and pressures by using an equilibrium-accelerating catalyst in the oil. For the sake of distribution through the oil, it is best to have this catalyst in a colloidal condition. Colloidal metals, such as nickel produced by electrical disintegration, and colloidal carbon are good catalysts. *With the aid of these catalysts an equilibrium can be obtained at pressures as low as 400 or 500 pounds in using a heavy oil.* After equilibrium is obtained, the reaction mixture can be cooled to the ordinary temperature and will then generally show a gauge pressure of about 120 pounds, this being due to permanent gases formed."

Conditions of Cracking

Before entering upon any further discussion of Snelling's patent, it may be advisable to insert parenthetically at this point—in order to make additional comment on Snelling's "equilibrium patent" more clear—a somewhat elementary discussion of cracking, rate of cracking, equilibrium in cracking and similar subject matter.

The phenomenon of so-called "cracking" of hydrocarbon oils was discovered in this country, accidentally, about 1861-62—just a few years after the discovery of oil when the famous Drake well was drilled near Titusville, Pa. "Cracking," as such, therefore, is an old operation as compared with many of the more modern methods of refinery technology.

With the commercial development of the Burton process for cracking oils in 1912-13, however, there became more added interest in the development of processes for making products from petroleum that do not exist in the original crude oil: in other words, methods for making from any given crude oil larger quantities of gasoline than ever before was possible by ordinary refinery procedures. During the period from 1913 to date, consequently, there has been developed on an extensive commercial scale such cracking processes as the Dubbs, Cross, Holmes-Manley, Tube-and-Tank, Jenkins, Buerger and others. Although these processes are conducted in apparatus that is often somewhat dissimilar (to the layman) in appearance, nevertheless they all accomplish the same general result, namely, the breaking-up of heavy hydrocarbons either into gases, lighter oils and coke or gases, lighter oils and heavier, or fuel oil.

"Cracking" is just what its name implies: the large, heavy-oil particles (molecules, to be exact), are cracked or split up into two or more pieces or particles (molecules), as a result of which the proportion of smaller or "lighter" particles is greatly increased. Cracking is generally accomplished by applying heat and pressure to the oil, although in some more common refinery operations, heat alone is used.

Rate of Cracking

Since the *rate* at which Snelling operates his process is an important factor in the success of his invention, a few commonly-accepted factors entering into the *rate of cracking* should be of interest.

It is a generally-considered fact that the time required for any given quantity of cracked products to be formed decreases as the temperature of the oil or vapor (or both) rises, due, largely, to the increased speed of the individual particles or molecules of which the oil is composed. As would be expected, these particles move among themselves much faster, the higher the temperature, and in so doing they bump into each other more frequently and more violently. One of the most widely-accepted theories for the explanation of the cracking or decomposition of petroleum is that "cracking" results from these rapid collisions of the individual particles. However, other plausible explanations for cracking have been advanced by oil technologists, but such reasons will not be given at this time since a discussion of the theories of cracking is considered as being beyond the scope of this article.

In any comment concerning the rate of

(Continued on page 116)

Recovery of By-Products from Acid Sludge

By GEO. W. CUPIT, JR.
Chemical and Refining Engineer

THE most efficient method for disposing of acid sludge in the larger refineries has always been a problem in the refiner's mind. By the term "larger refineries," I mean those which manufacture the majority of products, or all grades of products, obtainable from various types of crude oils.

The term "Full Refineries" may be applied here as meaning those which manufacture a full line of petroleum products. To be more specific, I shall mention: The Texas Company at Port Arthur, Texas; The Standard Oil of Indiana, at Whiting Ind.; The Standard Oil of New Jersey, at Bayonne, N. J.; The Standard Oil of New York, and The Atlantic Refining Company at Philadelphia. There are many other refineries throughout the country that may be put in this class, but these will suffice to illustrate.

The acid sludge to which I refer principally is that which is obtained by acid treatment of reduced paraffine base crudes, for example: Burbank, Powell, Tonkawa, Ranger, Pine Island (light), etc. All of these crudes show exceptionally good tests for "Assay Distillation" (over to 608 degrees Fahrenheit), sulphur content, high gravity and percentage B. S. at 70 degrees and 100 degrees Fahrenheit. Therefore, from a thorough examination of the crudes and the assay distillations on the same, one is given an opportunity to predict with marked accuracy what the nature of the sludge will be upon acid treating of the Reduced Crude. The nature of the base, however, is the governing factor. Crudes possessing both asphaltic (or naphthenic) and paraffine base properties cast a different light upon the subject. In this case it is not so easy to predict what the exact nature of the acid sludge will be.

Typical Examples

In the majority of cases the acid sludge from a paraffine base crude will not treat up well by the same method as that used on an asphaltic or naphthenic base oil. In other words, the results will, by no means, be the same.

Let us take as our starting point the preparation of the sludge from which we intend to recover asphaltic by-products. Any of the above oils will answer the purpose. If we choose Tonkawa crude, which has an average gravity of 43.0 degrees Baume, with an average of 43 per cent over at 410 degrees Fahrenheit and 68 per cent over at 608 degrees Fahrenheit, it will be best to reduce it to 150-160 viscosity (at 100 degrees Fahrenheit Saybolt) bottoms for acid treating. If Burbank crude, with an average gravity of 39.5 degrees Baume, and an average of 65 per cent over at 608 degrees Fahrenheit is chosen, it will be best to reduce it to approximately 25.5-26.0 degrees Baume. The reason for this is obvious.

Assuming that this has been done, the next step is that of treating the reduced crude to the extent of one pound per gallon of 93.5 per cent (H_2SO_4) sulphuric acid, in the case of reduced Tonkawa crude, or in the case of reduced Burbank crude, one pound per gallon of 98.0 per cent (H_2SO_4) sulphuric acid. In each case the chemical reaction is quite different. In the former we have an addition reaction, and in the latter, not only an addition reaction, but likewise a substitution reaction. The question that arises then is the following: "Will the asphalt constituents of the two acid sludges formed be different to any extent?" The answer is "No." The tests on the recovered asphalt products will differ slightly. In the case of treated reduced Burbank crude, the treating loss will be greater than in the case of treated reduced Tonkawa crude. The reason for which is also obvious. The nature of the two acid sludges obtained from both reduced crudes are so much alike that only one process for the recovery of asphalt products will be discussed.

After the crudes have been reduced to the right viscosity bottoms or gravity bottoms, it is pumped into the treating agitator, care being taken that the right treating temperature, 100-110 degrees Fahrenheit, has been obtained by regulating its flow through a heat exchanger (where continuous topping is applied) or through a cooling coil, (where batch reducing has been applied.) Most refineries now use semi-continuous, or continuous methods, for reducing this grade of crude to be used in bright stock manufacture.

When the agitator is charged with reduced Tonkawa crude the acid (93.0 per cent H_2SO_4) is either pumped or blown overhead without agitation with air, the reason for which is due to the fact that only 7 to 10 minutes blowing are necessary to cause a breaking between oil and acid sludge. The time required to add the necessary amount of acid would be more than eight times that required to finish the acid treated oil. Hence the treated reduced oil would show a breaking before all acid had been added.

In the case of reduced Burbank crude, the 98.0 per cent H_2SO_4 may be added with air agitation, due to the fact that this oil requires a much longer time to treat. Hence the required amount of acid may be added before a breaking between oil and acid sludge is observed. At the breaking point, agitation is stopped and the sludge is allowed to settle approximately two hours, after which time the sludge may either be pumped from the bottom of the agitator or drawn down by gravity into a sludge cooking kettle.

Operation in the Cooking Kettle

Unfit gas oil (unfit as pressure still charging stock) having a gravity of 24 to 28 degrees Baume is charged into the kettle to the extent of approximately one-third of the volume of acid sludge to be treated. An equal volume of water is added and the contents brought to approximately 190 degrees Fahrenheit, with open live steam. This procedure should have been done prior to adding the acid sludge. With the steam on, remove the sludge from the agitator and allow to steam 6 to 8 hours. At the end of this time the sludge, oil and water will have broken into three layers—namely, acid oil or acid tar on the top, acid coke in the middle, and spent acid on the bottom.

In this condition the contents are allowed to settle approximately 14 to 16 hours to insure complete separation. It is not difficult to understand why this length of time for settling is recommended, when it is learned that 720 barrels of acid sludge were treated at one time.

After complete separation has taken place, determined by testing the petcocks on the kettle from top to bottom, the acid oil is pumped from the top of the kettle into a storage tank. The spent acid, having a gravity of from 35 to 40 degrees is drawn off into an acid pit and thence pumped to a weak acid storage tank through lead lines.

To the acid coke which remains in the kettle 300 barrels of hot water are added, and again steamed for four to five hours and allowed to settle two to three hours. At the conclusion of this steaming only two layers are are formed, acid coke on top and weak acid (28 to 30 degrees gravity), on the bottom. The spent acid is run off by gravity into an acid pit and pumped from thence to weak acid storage tanks.

To the acid coke is added approximately 100 barrels of spent soda ash solution (from a previous treat) and the contents steamed for one hour. This is done to neutralize the remaining acid

in the coke, thereby cutting down appreciably the amount of strong soda ash necessary to completely neutralize the acid coke. After an hour's cooking, allow to settle one hour and draw off the salt-acid solution to the sewer.

To the acid coke is added approximately 120 barrels of 33 degrees gravity soda ash solution and live steam for one hour. The contents of the kettle will be very viscous. To take care of this the acid oil pumped off the top of the kettle on first separation is pumped back to the kettle and the contents steamed one hour longer. Two hundred barrels of hot water are now added, and the contents steamed six to eight hours and allowed to settle eight to ten hours.

The kettle contains at this stage asphalt stock (on top) and spent soda solution (on bottom). The spent soda ash solution is pumped to a storage tank and held for another treat. The asphalt stock is retained for further still reduction and oxidation to desired asphalt products.

Reduction to Asphalt Products

Preparation for Charging: The pipework, still charging lines and worms should be inspected and steam coils tested to make sure there is no blockage. The side and top manheads are put on and top steam induced for fifteen minutes.

Charging: The charging line is opened and still is charged to the specified outage determined by pet cocks at the rear end of the still.

Firing: When charged, the fires are started at full capacity until the temperature of the still has reached approximately 195 degrees F., at which time, if the charge has moisture in it there will be signs of pressure at the safety valve. At this point the fires are checked and still contents allowed to subside until moisture is off, at which time a small stream will be running in the light worm, and the safety valve will be showing no pressure. Full blast is then put on fires until the temperature of the still reaches 350 degrees F. At this temperature bottom steam is started gradually into the still, increasing just as fast as the still will take it. From this point the still temperature is increased 25 degrees per hour, until 425-430 degrees F. has been reached. A sample of the still should be taken and tested for melting point. If the test shows approximately 90-95 degrees M. P. the reduction should be watched carefully as 100 M. P. is that desired on the bottoms. When the desired M. P. has been reached the still is ready to pump out.

Pumping Out Still: When still is finished, bottom steam is taken out and enough top steam put in to kill the existing gases. The safety valve is raised and the finished asphalt is pumped through a cooler at an approximate temperature of 500 degrees F. or below, into an oxidizer.

Oxidation to Desired Melting Point Product: There are various types of oxidizers now in service throughout the oil refineries. Those that are used most are the horizontal and vertical still type oxidizers. Some refineries have converted an ordinary horizontal still into an oxidizer by making necessary changes in the burners, air line distribution, heating surface, etc.

Type of Oxidizer

The type of oxidizer which has given the most satisfactory results is the vertical beehive type. The name is self-descriptive. The features regarding this oxidizer are: large heating area, capacity for handling large amounts of oxidizable products, heat distribution and control.

In order that as little heat as possible may be lost in pumping from the still to the oxidizer, the oxidizer is built a short distance from the rear of the still.

After the oxidizer is charged, the temperature of the contents is noted. If the temperature has dropped below 450 degrees F. (depending on the distance between still and oxidizer, weather conditions, and heat transmission coefficient) it should be raised to 450-475 degrees F., at which time top steam is added gradually and in small quantity at first, increasing same until a full valve has been fed to the oxidizer by the time the still temperature has reached 520 degrees F. At this point the fire should be checked and the air induced through the spider or steam coil until the temperature has been raised by the air to 550-560 degrees F. and kept there. At 560 degrees F. hourly samples should be tested for melting point desired.

Various melting point products made by this process from acid sludge from treated reduced crude gave the following tests:

	No. 130 M.P.	No. 180 M.P.	No. 220 M.P.
Melting Point			
B & R	130	180	220
H & C	147	193	244
Spec. Grav. at 60° F.	1.0153	1.0128	1.0013
Flash O. C.	570	570	570
Fire O. C.	650	630	625
Fixed Carbon	14.42	17.42	20.08
Ash	.08%	.14%	.25%
S. D.	1.08%	1.20%	1.27%
Sol. in CS2	99.72	99.80	99.86
Sol in CC14	99.72	99.84	99.88
Insol. in 86° Naph.	17.11	20.79	40.90
Ductility at 77	110	2	
Penetration 100-5-77	40	12	4
Penetration 100-5-32	4	1	
Penetration 50-5-111	251	18	2

The evaporation loss was almost nil on each of these products. By studying the tests on these products it is readily seen that they are of a superior quality; high in melting point, low in evaporation, reasonably low in sulphur content, possess exceptionally good flash and fire points, and show a high percentage solubility in the inert solvents (CS2 and CC14).

Special Asphalt Products

When especially high melting point products are desired having high flash and fire points, these products, which are, as a rule, made into fuel and burned, may be recovered and sold as such. At present such products would, no doubt, be classified as "special asphalt products," although in one or two instances they have been used straight or compounded for practical purposes.

Another asphalt product obtained from acid sludge and which has found its way not only into the asphalt business, but into the paint business too, is one made from acid oil, (sometimes called acid tar). Acid oil, it will be remembered, is the top layer formed on cooking acid sludge. After complete separation of cooked acid sludge has taken place, by sufficient settling the acid oil is pumped directly into the still for reduction to desired M. P. The method of charging the still is the same as that already mentioned above.

After the still is charged, (1200 barrels) it is fired at full blast until the temperature reaches 450 degrees F. At this temperature approximately four or five spokes of the top steam are added and a half valve of air induced through steam coil, gradually, until the full valve has been added. At 500 degrees F. temperature the fires are checked. The air, however, is continued and the temperature is raised by air oxidation to 530-550 degrees F. and kept there. When the temperature has reached 530 degrees F. samples are taken and tested every two hours for melting point.

When the melting point has reached 210 degrees F. the air is taken out of the still and the top steam induced, the reason for which is obvious.

Sludge By-Products

The product formed by this process will be very smooth, glossy, and brittle. The latter characteristic allows it to be easily pulverized, and in this state it serves as an excellent pigment for paints. Its glossy characteristic serves to give the paint a smooth and even surfacing.

It has been found by experience in processing this product that the temperature should not exceed 550 degrees F., and the pumping out temperature should not exceed 450 degrees F.

While we are discussing the manuacture of asphalt by-products from the

(Continued on page 124)

Gasoline Plants Provide Gas for Flowing Oil Wells

Forrest E. Gilmore Company uses small units of high salvage possibilities in meeting needs of recent field methods

By GEORGE REID
Associate Editor

THE Forrest E. Gilmore Company of Tulsa, has recently completed construction of three compression type natural gasoline plants in the Bowlegs field at Seminole, securing gas from the leases of the Atlantic Oil Producing Company. In addition to the manufacture of stable compression gasoline, these units were designed for supplying residue gas under sufficient pressure for the operation of the producing company's wells on the gas lift system of pressure flowing.

Operating under this system these plants are among the few gasoline installations which are so designed that pressure flowing of the oil wells is incidental to the plant's operation. Most of the compression plants in the Seminole area were installed primarily as gas lift plants —preparing natural gasoline incidentally, and collecting this product for storage at whatever specifications and characteristics such a product may have. The Gilmore plants are firstly gasoline plants, and secondly, gas lift plants—being designed for the efficient manufacture of gasoline, but operating at sufficient pressure that the residue gas is regulated outside of the plant yards to the pressure required for flowing the oil wells. The gas, being repeatedly recycled from plant to oil well is, of course, enriched in gasoline content with each recycling.

Since all three plants are virtually duplicates of the original installation, only one will be described in detail. Gilmore's No. 7 is located on the Fleet lease of the Atlantic Oil Producing Company in section 23-8-6, Bowlegs pool. Like the company's other installations this one incorporates some of the features of portability and high salvage value. The plants are constructed in such a manner that virtually all of the essential equipment is compact, easily accessible for removal. In view of the general smallness of the entire plant, — compressors, condensers, fractionating equipment, and accumulators, it is interesting to note the large volume of natural gasoline handled and the relatively large gallonage production per plant. The accompanying illustrations show something of the size and type of equipment. Three compressor machines are handling from 3,500,000 to 4,000,000 cubic feet of gas daily, operating at 300 pounds pressure, and the plant produces from 9000 to 10,000 gallons of gasoline daily.

Operating Method

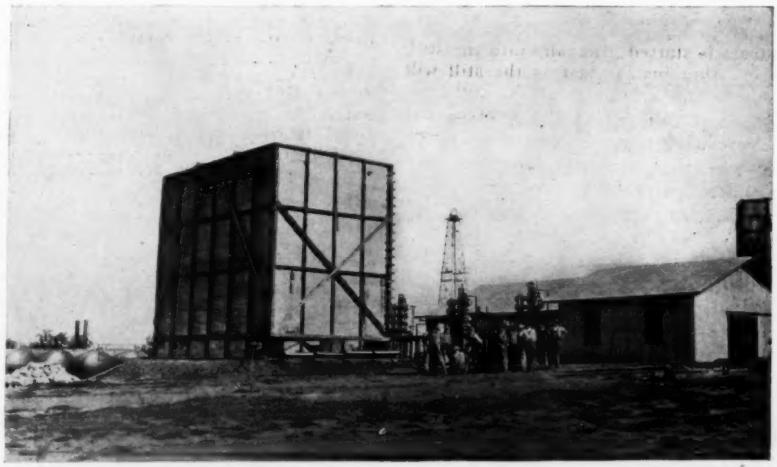
The three machines are Clark Brothers 810 horsepower twin engines direct connected to 15 by 20-inch and 7 by 20-inch compressor cylinders. The engines are equipped with fuel savers which inject the fuel gas in through the engine head after the burnt gases have been removed, which practice is said to give the engines more power and fuel efficiency comparable with four cycle engines. Each low pressure cylinder pumps the gas from a 12-inch header supported above the cylinder, through a six-inch pipe to an oil separator. From this separator or scrubber the low pressure gas passes into the upper section of the two-section 10-inch condenser. The bottom section of each of these condensers discharges into a six-inch manifold which in turn discharges into a bubble type fractionating tower, 72 inches by 48 feet in dimensions.

The cooled low pressure gas flows upward through the fractionating tower to emerge from the top, where it is conducted through a heat exchanger and into a second 12-inch header. The high pressure side of the compressor then pumps this gas at 300 pounds, through four-inch lines to oil scrubbers and into the top section of five-section condensers. These condensers are of the tubular counter flow type—as shown in the accompanying illustrations. From the condensers the high pressure gas is discharged into a 36 by 72-inch accumulator tank. Separation of the condensed gasoline occurs here, and the gas from these tanks is piped through a back pressure regulator to a manifold where it is distributed to various lines and measured out to the oil wells producing under the gas lift system of pressure flowing.

Gasoline, as it accumulates in the high pressure accumulator tank is conducted into the top of the fractionating tower, where its evaporation produces a comparatively low temperature. This vapor is in contact with the low pressure gas rising through the bubble type tower, which is injected into the bottom of the tower as previously described. The plant production comes entirely from the bottom of the tower, where the condensed accumulating gasoline, governed by liquid level controllers, is run to storage. This gasoline passes through the heat exchanger, through which the cold gas from the top of the tower is also passed, and thus the gasoline is cooled before reaching the storage tanks.

One of the high pressure cylinders is equipped with discharge piping so arranged that by closing one valve and opening another, after first unloading the low pressure cylinder, a pressure as high as 1200 pounds per square inch may be obtained to be employed for starting the flowing of an oil well, or what is called, "breaking out."

Water pumps for handling cooling water, are located in a 20 by 24 foot



GENERAL VIEW OF FORREST E. GILMORE COMPANY'S FLEET LEASE PLANT AT BOWLEGS-GREATER SEMINOLE FIELD. DETAILS OF WATER COOLING TOWER CONSTRUCTION ARE SHOWN. NOTE DOORS OPENED IN DIRECTION OF PREVAILING WIND

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Charge: Salt Creek Long Residuum	Flash	425° F.	425° F.	425° F.	425° F.	425° F.	425° F.	425° F.	420° F.	420° F.	420° F.
	Fire	485° F.	485° F.	485° F.	490° F.	490° F.	490° F.	490° F.	480° F.	480°	480° F.
	Amount	4000 cc.	4000 cc.	4000 cc.	4000 cc.	4000 cc.	4000 cc.	4000 cc.	3000 cc.	4000 cc.	4000 cc.
Total 66° Acid		45 lb./bbl.	45 lb./bbl.	45 lb./bbl.	45 lb./bbl.	45 lb./bbl.	45 lb./bbl.	45 lb./bbl.	45 lb./bbl.	45 lb./bbl.	45 lb./bbl.
First Dump	Acid, lbs. per bbl.	45	22.5	30	15	15	17	30	20	5	8
	Acid—grams	514.8	257.4	343.2	171.6	171.6	194.5	343.2	171.6	57.2	92.0
	Air Agitation Time	20 Min.	25 Min.	20 Min.	30 Min.	30 Min.	20 Min.	45 Min.	30 Min.	25 Min.	25 Min.
	Air Agitation Temp.	140° F.	140° F.	140° F.	140° F.	140° F.	140° F.	140° F.	140° F.	140° F.	140° F.
	Settling Time	17 Hrs.	15½ Hrs.	15¼ Hrs.	5½ Hrs.	5½ Hrs.	5½ Hrs.	6½ Hrs.	5½ Hrs.	15½ Hrs.	15¼ Hrs.
	Settling Temp.	140° F.	140° F.	140° F.	140° F.	140° F.	140° F.	140° F.	140° F.	140° F.	140° F.
	Cc. Sludge	1350 cc.	1140 cc.	1200 cc.	900 cc.	900 cc.	990 cc.	1225 cc.	800 cc	450 cc	580 cc.
	Cc. Acid	281 cc.	141 cc.	187 cc.	94 cc.	94 cc.	106 cc.	187 cc.	94 cc.	31 cc.	50 cc.
	Cc. Oil Lost	1067 cc.	999 cc.	1013 cc.	806 cc.	806 cc.	784 cc.	1038 cc.	706 cc.	419 cc	530 cc.
	Per Cent. Loss	26.72	24.98	25.32	20.15	20.15	19.60	25.95	23.53	10.48	13.25
Second Dump	Acid, lbs. per bbl.		22.5	30	15	15	17	10	15	20	27
	Acid—grams		257.4	171.6	342.2	171.6	194.5	114.4	128.7	228.8	308.
	Air Agitation Time		30 Min.	30 Min.	25 Min.	25 Min.	25 Min.	30 Min.	30 Min.	30 Min.	30 Min.
	Air Agitation Temp.		140° F.	140° F.	140° F.	140° F.	140° F.	140° F.	140° F.	140° F.	140° F.
	Settling Time		7 Hrs.	7 Hrs.	16¼ Hrs.	15¼ Hrs.	16¼ Hrs.	15½ Hrs.	15 Hrs.	7 Hrs.	7 Hrs.
	Settling Temp.		140° F.	140° F.	140° F.	140° F.	140° F.	140° F.	140° F.	140° F.	140° F.
	Cc. Sludge		360 cc.	250 cc.	525 cc.	375 cc.	360 cc	140 cc.	190 cc.	660 cc.	610 cc.
	Cc. Acid		141 cc.	94 cc.	187 cc.	94 cc	106 cc	62 cc.	70 cc.	125 cc.	169 cc
	Cc. Oil Lost		229 cc.	166 cc.	338 cc.	281 cc.	254 cc.	78 cc.	120 cc.	535 cc.	441 cc.
	Per Cent. Loss		5.70	4.16	8.45	7.03	6.85	1.95	4.0	13.38	11.03
Third Dump	Acid, lbs. per bbl.					15	11	5	10	20	10
	Acid—grams					171.6	125.8	57.2	85.8	228.8	114
	Air Agitation Time					30 Min.	30 Min.	30 Min.	30 Min.	30 Min.	20 Min.
	Air Agitation Temp.					140° F.	140° F.	140° F.	140° F.	140° F.	140° F.
	Setting Time					6¾ Hrs.	6¼ Hrs.	7½ Hrs.	7¼ Hrs.	14½ Hrs.	14½ Hrs.
	Setting Temp.					140° F.	140° F.	140° F.	140° F.	140° F.	140° F.
	Cc. Sludge					240 cc.	175 cc.	65 cc.	85 cc.	280 cc.	100 cc.
	Cc. Acid					94 cc.	69 cc.	31 cc.	47 cc.	125 cc.	62 cc.
	Cc. Oil Lost					146 cc.	106 cc.	34 cc.	38 cc.	155 cc.	38 cc.
	Per Cent. Loss					3.65	2.15	0.85	1.00	3.88	1.00
Total Settling Time		17 Hrs.	22½ Hrs.	22½ Hrs.	22 Hrs.	47¼ Hrs.	45¼ Hrs.	29½ Hrs.	27¼ Hrs.	37 Hrs.	36¾ Hrs.
Total Loss—%		26.72	30.68	29.48	28.60	30.83	28.60	28.75	28.53	27.74	25.28
Acidity		1.07 mg.	3.03 mg.	2.99 mg.	1.28 mg.	3.33 mg.	3.23	2.26 mg.	2.44 mg.	1.16 mg.	0.90 mg.

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Fractional Addition of Acid

Generally, a more efficient treatment of the oil is obtained, with the same amount of acid, if the acid be applied to the oil in several portions (settling being allowed and the acid sludge drawn off after each individual treatment) than if the acid were all added at one time.

Concerning the reasons for this increased tendency of the acid and oil to react, with consequent more efficient results, when the acid is applied in fractional "dosages," Gurwitsch[1] has the following to say:

"It seems probable that the action of sulphuric acid on asphaltic substances and unsaturated compounds of high molecular weight may take place in several phases; that at the commencement of this action reaction products are separated from the distillate, and that these further react with the excess of acid. It has been observed in the refining of certain petroleum products that, by the addition of a very small quantity of acid, a very feeble acid sludge is separated, by far the greater part of which is soluble in benzine; but when this sludge is further treated with sulphuric acid it reacts with the latter and almost entirely loses its solubility in benzine. The same sludge, insoluble in benzine, is also formed when the crude product is at once treated with a large quantity of sulphuric acid. In cases like this, it is easy to see that the fractional addition of acid must have a greater effect than addition at one time, as in the latter case a portion of the acid is employed in the entirely useless operation of carrying out a further change in the compounds already separated. Whether this explanation is generally applicable, it is impossible to say at present.

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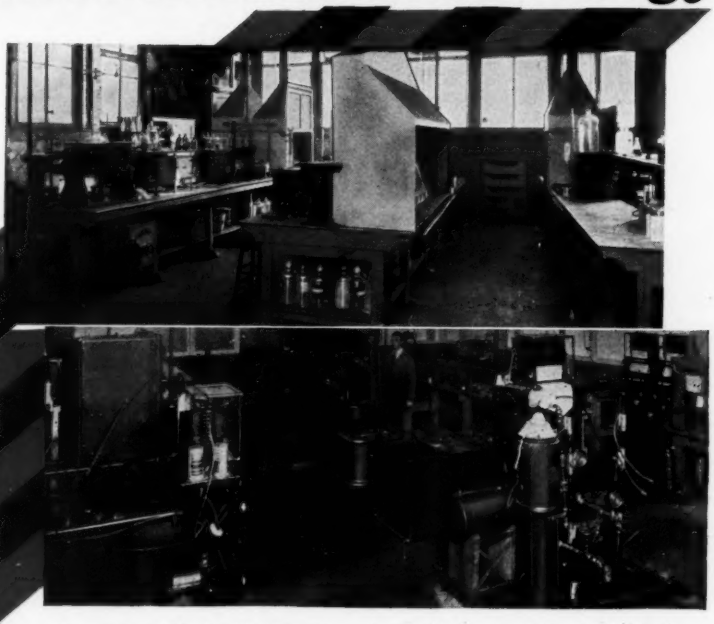
"In cases where refining is carried out with large quantities of fuming sulphuric acid, and where the principal object is as complete a decolorization as possible of the product, the fractional addition of acid has still the advantage that an elevation of temperature detrimental to the decolorization is avoided.

"Finally, the very common case in which the crude product contains water may be considered. As the strength of the acid has a powerful influence on the refining effect, it is always advantageous to free the distillate from the last traces

(Continued on page 102)

[1]Gurwitsch, "The Scientific Principles of Petroleum Technology." Translated and revised by Harold Moore. Pps. 337-338 (D. Van Nostrand Company, 1927).

The Background of Correct Technology



Research and Testing Laboratories. Chemical (above) and Physical (below)

Smith Engineering and Technical Service

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Discovery of weak points in the design by strain measurements and stress analysis.

Application to design of the results of elevated temperature, fatigue, and corrosion tests.

Selection and application of the correct materials to overcome unusual and difficult processes.

Controlling of Materials

To formulate such specifications as are best suited for the particular requirements in each case.

Inspection, analysis, and testing of the metals to insure that they do conform to the specifications.

Supervision of shop procedure to insure safe fabrication.

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A. O. SMITH CORPORATION :: *Milwaukee, Wisconsin*

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First Dump	Acid, lbs. per bbl.	45	22.5	30	15	15	17	30	20	5	8
	Acid—grams	514.8	257.4	343.2	171.6	171.6	194.5	343.2	171.6	57.2	92.0
	Air Agitation Time	20 Min.	25 Min.	20 Min.	30 Min.	30 Min.	20 Min.	45 Min.	30 Min.	25 Min.	25 Min.
	Air Agitation Temp.	140°F.	140°F.	140°F.	140°F.	140°F.	140°F.	140°F.	140°F.	140°F.	140°F.
	Settling Time	17 Hrs.	15½ Hrs.	15½ Hrs.	5½ Hrs.	5½ Hrs.	6¼ Hrs.	6¼ Hrs.	5¾ Hrs.	15½ Hrs.	15¼ Hrs.
	Settling Temp.	140°F.	140°F.	140°F.	140°F.	140°F.	140°F.	140°F.	140°F.	140°F.	140°F.
	Cc. Sludge	1350 cc.	1140 cc.	1200 cc.	900 cc.	900 cc.	990 cc.	1225 cc.	800 cc	450 cc	580 cc.
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	Air Agitation Temp.	140°F.	140°F.	140°F.	140°F.	140°F.	140°F.	140°F.	140°F.	140°F.	
	Settling Time	7 Hrs.	7 Hrs.	16¼ Hrs.	15¼ Hrs.	16¼ Hrs.	15¼ Hrs.	15 Hrs.	7 Hrs.	7 Hrs.	
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Overtime Will Defeat Purpose of Incentive Wage Plans

By L. A. SYLVESTER
Industrial Engineer, The Atlantic Refining Company

"IT DOES not seem fair to ask our bonus workers to come in Sunday and work for a 30 per cent bonus at 100 per cent efficiency and perhaps on the same job pay double time on operations which we have not yet covered with rates," said a department superintendent at a Rate Committee meeting.

"Well, in order to end this discussion, suppose we have a study of this problem made and settle it definitely once and for all," said the manager.

Such was the beginning of a very interesting study as to just what is accepted as good practice and how workers should be paid in incentive wage plans when they are required to work beyond their normal working day.

Of recent years the payment of time and half on overtime has become a common practice and, strange to say, there seems to be a certain amount of disagreement as to just why this added amount is paid. It has been argued, on one side, that as the length of the day increases the value of a worker decreases and that a worker should be compensated in proportion to his actual worth. On the other hand, it has been argued that while the worker's value may decrease his expenditure of energy increases and consequently he should be compensated more highly.

It seems to be, however, the general consensus of opinion that overtime is paid for mainly for two reasons:

1. Overtime is paid to discourage the working of employes beyond the normal working day by imposing upon the management a penalty of time and half or double time.

2. An increase in pay per hour is in recognition of the increased cost in effort to the worker.

Regardless of the exact reason why we pay overtime it is a fact that it has long been urged by organized labor, and during the World War the practice was rapidly and widely extended in American industry.

The problem of overtime payment of incentive workers has been approached from two different angles in a recent investigation which is the subject of this paper.

1. How do representative large industrial plants handle this matter?

2. What is the fundamental relationship of the length of the working day and efficiency on incentive operations?

While one need not necessarily be controlled by the actions of others, it is always illuminating to find out what the more progressive and forward looking organizations are doing. Such information is both a source of inspiration and a good general guide to judgment.

The real secret of the solution of the problem lies in the fundamental relationship of efficiency and overtime. Unfortunately, there is not a large amount of data on this subject but such as does exist is sufficient to develop a substantial back-ground for action.

Current Practice of Twenty Large Plants In Regard to Overtime

A questionnaire was sent to a number of large manufacturiing plants. A careful analysis of the answers received is shown in Fig 1. A study of this table is well worth while and reveals many interesting facts.

1. There is, first of all, a general agreement that the efficiencies of piece workers decline on overtime. Regarding this particular point more will be said later; it is mentioned here to draw attention to the fact that what has been demonstrated by laboratory tests and special observations is confirmed by the practical experience of everyone questioned.

Experiments and special observations deal necessarily with individual cases and in drawing conclusions from practical cases a certain amount of skepticism is justified as to whether the conclusions are susceptible to universal application. Therefore, these answers should lend credence to the fact that the efficiencies of piece workers decline on overtime.

2. It seems to be customary to pay from 5 to 15 per cent bonus for permanent night shift work. Such a bonus naturally is merely an added inducement to attract good workers to the night shift, thus minimizes supervision and also provides extra compensation for the added inconvenience of working at a time other than the normal working hours.

3. Out of the 20 companies answering, it will be noted that the method of paying overtime in connection with piece rates is as follows:

Piece rate and one half hourly rate	7
Piece rate plus one half of average earnings	1
Piece rate plus 10 per cent	1
Straight piece rate	5
Straight time and half	4
Have no piece rates	2

Analyzing these answers it should be noted that the wide use of wage incentive plans being made today is brought out in this summary by the fact that out of 20 companies only two, or just 10 per cent, report that they do not use incentive rates. Of the remaining 18, one half pay a premium in addition to the piece rate for overtime work, and the majority of these pay the regular incentive rate plus one half of the hourly rate for overtime. It might be well to add here that the average size of the plants which report paying piece rate plus one half of the hourly rate is considerably larger than the average size of the other plants reporting.

4. With regard to the delays caused through no fault of the workers, it appears that the making of day-rate allowances for the delayed time has become a well established practice. Out of the 20 companies answering 14, or approximately two-thirds, make use of this practice.

5. When workers receive time and half or double time for working holidays and Sundays no extra allowance appears to be made should their work extend beyond the regular working day. In other words, it is an extension of a normal working week, be it in the evening of a week day, holiday or Sunday and that it is not customary or even logical to compound overtime when working on Sunday evening or the evening of a holiday.

It has been developed by the written answers to the questionnaire that when piece rates or other incentive plans are installed overtime becomes quite infrequent. This fact is further corroborated by an investigation made by the Society of Industrial Engineers, the results of which have not been published.

To properly picture the relationship of overtime and efficiency it is necessary to review the fundamental concept of a standard or a task. When a time-study engineer makes his original observations of an operation upon which he intends to establish a rate, he will first arrive at a base time which would probably be equalled by a "perfect worker." The term "perfect worker" is meant to convey the idea of a frictionless machine, working with perfect regularity and with no power fluctuations or losses. The "perfect worker" would work with the regularity of an automatic machine and be free from all of the human losses that may be caused by personal comfort, fatigue,

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SHELL COMPANY OF CALIFORNIA
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Firm Number	What per cent of production workers are paid on:		How do you pay hourly rate workers for:			Is the extra wage increased as overtime increases?	How do you pay piece-workers for:			Is overtime payment controlled by union rules?	Are allowances made to piece workers for delays for which they are not responsible?	How are piece workers paid who are working overtime through some failure of their own?	How are piece workers paid who are working overtime because of breakdowns or causes over which they have no control?	Are piece workers permitted to leave early if they finish the day's task?	Is lateness enforced as strictly with piece workers as it is with hourly workers?	Do your records show that efficiency decreases as the amount of overtime increases?	Do you pay a bonus for night shift work?	Do you pay a bonus for calls at night, Sunday, or Holidays?	Do you pay any extra bonus or wage for overtime on Sundays or Holidays?	Do you pay any extra bonus or wage for overtime by night shift?
	Hourly Rate	Incentive Rate	Overtime	Sunday	Holiday		Overtime	Sunday	Holiday											
A. R Co.	92%	8%	1½	2	2	No	PR.	PR.	PR.	No	Not usually	Piece Rate	Piece Rate	Yes	Yes	No records	No	No time & ½	No double time	Straight time for shift work
1	None	All	1½	2	2	No	PR.	PR.	PR.	No	Yes	Not paid for time on spoiled work	Piece Rate	No, have no day's task	Yes	Yes	We have none	Only regular overtime rates	Regular overtime rates	Have none
2	16%	84%	1½	1½	1½	No	PR.	PR.	PR.	No	No	Regular Rates	Regular Rates	Yes	No	Not enough overtime to tell	No	Time and ½	Time and ½	No
3	18%	82%	1½	No overtime		No	Overtime=P.W. plus½ D.P.			No	Yes	Regular Rates	Regular Rates	Have no task limits	Not a problem & carries no penalties	Positively	No occasion for night shift	Would pay time and one half	Would pay time and one half	Would pay time and one half
4	20%	80%	1½	1½	1½	No	1½	1½	1½	Open Shop	Employees paid hourly rate plus bonus earned. We use the Parkhurst Bonus System			No	Yes	Not much overtime	Same as day	Yes	No extra bonus, 1½ time plus bonus earned	No extra bonus, 1½ time plus bonus earned
5		78%	1½	1½	1½		1½	1½	1½	No	Yes	Regular Rates	Regular Rates	No	Use one plan		6-hour shifts get 20% bonus			
6	25%	75%	1	1½	1½	No	PR.	PR.	PR.	No	Yes	Regular Rates	Regular Rates	No	Yes	Not enough overtime to tell	15% bonus for certain classes	Have none	No	No
7	25%	75%	1½	1½	1½	No	P.R. earnings plus ½ day rate			No	Day Rate	This condition does not exist	Piece work plus ½ day rate	No—no day's task	Not exactly	No records	10% over amount of wages earned	Day worker 1½, P.W. earnings plus ½ day rate	Day worker 1½, night worker+10%	This condition has never occurred
8	27%	73%	1½	2	2	No	Earnings plus ½ H.R. or reg. H.R.			No	Yes	Regular Rates	Regular overtime rates	No	Yes	Have no records, but think so	Yes	Sunday and Holidays plus H.R.	Sunday and Holidays plus hourly rate	Earnings plus ½ hourly rate or plus H.R.
9	30%	70%	1½	1½	1½		Bonus earned plus ½ hourly rate			Open Shop										
10	33%	67%	1¼	1½	1½	No	Overtime get 10% additional			No	Base hourly rate	10% additional	10% additional	Don't work on task output	Yes	Depends on individual	10% over day rates	10% over day rates		10% over day rates
11	66%	34%	Nothing extra			No	Straight time plus incentive			No	Yes	Straight time	Straight time plus incentive	Yes, for still cleaners	Yes	Insufficient experience	No	No	No	No
12	49%	51%	1½	2	2	No	1½	2	2	No	Not usually	Regular overtime schedule	Regular overtime schedule	No	Yes	Not as efficient	Yes, 5%	Regular overtime schedule	Regular overtime schedule	Regular overtime schedule
13	50%	50%	1¼	1½	1½	No	P.W. plus ¼ or ½ hourly rate			No	Straight hourly rate	Do not have this condition	Piece rate plus ¼ and ½ hourly rate	No set tasks	Yes	Not enough overtime to tell	No	No	No	No
14	50%	50%	1½	2	2	No	1½ time of hourly rate			No	Regular day rate	1½ time of hourly rate	1½ time of hourly rate	No	Yes	No records, but efficiency decreases	10% of total earnings	Overtime rates	Overtime rates	Overtime rates
15	60%	40%	Usually time and one half			No	P.W. plus ½ hourly rate			No Company schedule	Usually transferred	No additional pay allowed	Piece work plus ½ hourly rate	No	Yes	No record	No	1½ time for special cases	½ hourly rate plus piece work earnings	No
16	60%	40%	1½	1½	1½	No	Average plus 50%			Very rare cases	Yes	Same as others	Time and one half	No	Yes	Yes	Amounts to 36% bonus	1½ time to all hourly employees	Not beyond usual time and a half	Time and a half
17	80%	20%	1½	1½	1½	½ time at earned R. per hour	1½	1½	1½	Open Shop	Yes	Situation does not exist here	Time and half at day rate	No	Periodograph clock used by all workers	Very little overtime worked	No	No	No	No
18	100%		1½	1½	1½	No				No						Yes	No, use rotation system	No	No	No

Note ½=time and one half 2=double time P.W.=piece work H.R.=hourly rate P.R.=piece rate

FIG. 1 QUESTIONNAIRE ON OVERTIME PAYMENT OF HOURLY AND PIECE WORKERS

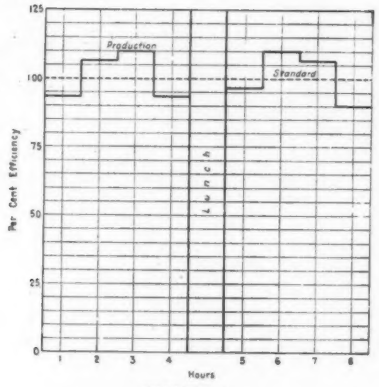


FIGURE 2

distraction, interruptions and many other factors to which every worker is subject.

Consequently, it has become a well established practice in rate setting to make an allowance over the base time, and a time study-engineer's ability to establish good standards depends very largely upon his ability to estimate how much these losses will amount to and how much decline in production there is likely to be just prior to the lunch hour and quitting time. Fig. 2 illustrates this relationship of actual production throughout the day to the standard. It is obvious that if a strictly first class worker is to average the standard production for an operation he must at some time in the day exceed the standard, since he is sure to fall below it as the effects of fatigue set in. In other words, the ability to establish good standards can to a certain extent be viewed as the ability to foretell how much the standard must be lowered in order to permit the first-class worker to average the standard task in the course of a day.

While there are not many data available as to the total output of 100 per cent efficient workers, the general consensus of all those having practical supervision of incentive work is that two or three hours overtime is about the maximum that is advisable on heavy manual labor operations without very seriously impairing efficiency, and also that two or three hours overtime is not practical except on rare occasions.

Fig. 6 gives figures which have been developed from published data on the effect of overtime. The information which was published by Prof. G. H. Shepard[1] is probably the best, because it was taken carefully under controlled conditions.

Fig. 3 gives a typical curve of production on a strictly manual labor operation. It should be noted in this curve that the irregularities due to the effect of fatigue and subsequent rest periods and lunch time have been smoothed out. This curve is shown in this form because it is believed that the tendency is better illustrated. The curve represents the net failing tendency of a first-class worker in spite of all that rest and lunch periods may do.

Fig. 4 gives a fairly similar curve, somewhat flatter in shape but of the same general type. These data were collected under actual production conditions and consequently may contain more variables than the data shown in Fig. 3. Even assuming that a lunch period were introduced sometime after the ninth hour of the work it is unlikely that the general tendency of efficiency to fall could be prevented for any great length of time. The destruction of tissue has at this point so impaired the efficiency of the muscles, and so much deleterious substance has been accumulated in both blood and muscle, that sleep is necessary to permit the proper recuperation of the body. Even were it practical to allow workers a rest including sleep for a few hours, it would hardly seem to be a wise policy except in rare and extreme emergencies. While these curves may not be strictly true it is believed that after two or three hours of overtime the average efficiency of a worker over the entire working period will have dropped to such a level that the loss of bonus will completely off-set a time-and-half-time payment for overtime.

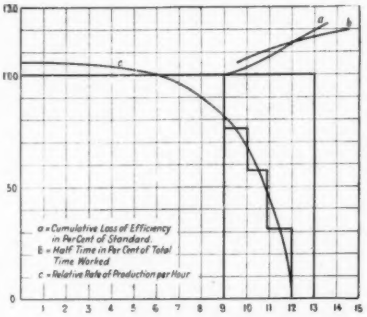

a = Cumulative Loss of Efficiency in Per Cent of Standard.
B = Half Time in Per Cent of Total Time Worked
c = Relative Rate of Production per Hour

FIGURE 3

Line A in Figs. 3 and 4 shows the cumulative loss and efficiency in per cent of standard, while line B shows the overtime payment in per cent of the total time worked.

Assuming that a bonus is being paid at a rate which calls for an increase of one per cent bonus for each one per cent in efficiency, then the points at which lines A and B intersect will be the point at which the cumulative loss in per cent of bonus earned will have completely wiped out the time-and-half payment. The output curve of an average day worker, if plotted on these charts, would probably start somewhere around 65 per cent and drop in the same type of curve reaching zero in about 18 to 36 hours, depending upon the strength of the worker, type of the work and other varying conditions.

General Conclusions

Our general experience at the Point Breeze plant confirms Harrington Emerson's statement that the average worker on a day rate is about 66 per cent efficient. Initial efficiency at the beginning of installation work in 15 different projects at the Point Breeze plant averaged about 60 and 65 per cent efficiency. Having already established ward and also the overtime compensation of time-and-half.

It would seem highly probable that the higher the efficiency of the worker the more rapidly production may decline in overtime. In other words, it would appear highly probable that when a worker pushes himself beyond an optimum speed of work that he does it at the expense of the length of the time that he can work at the task daily. Whether this is true or not has not as yet been definitely established.

Figs. 3 and 4 bring out very clearly the reprehensible nature of repeated and excessive overtime on incentive work. The increase in production that is secured by lengthening the working period is at the physical expense of the workers and if extended beyond a very short number of extra hours daily, even payinig incentive rate plus half of the hourly rate, workers are in danger of ont only excess physical cost but a relative actual financial loss due to lower efficiency. The incentive worker on a long stretch of overtime will earn little or nothing over his base rate plus the practice that day workers on overtime are worth time-and-half it would seem reasonable that a 100 per cent efficient worker should at least have an equal value when working beyond the normal day. In bringing a group of workers from the status of day work to the status of strictly incentive work, and in making them step from say 65 to 100 per cent efficiency, it is necessary to offer a substantial efficiency reward. This reward is purely a compensation for the increased production and if a low efficiency worker, whose efficiency is probably not even known is paid time-and-half, it seems only logical that the strictly first-class operator should receive both the efficiency reovertime, and he actually loses the efficiency reward to which he is properly entitled if working a normal day. It would seem that it should be established as almost an "ironclad rule" that strictly manual labor operations when on an incentive basis should be forbid-

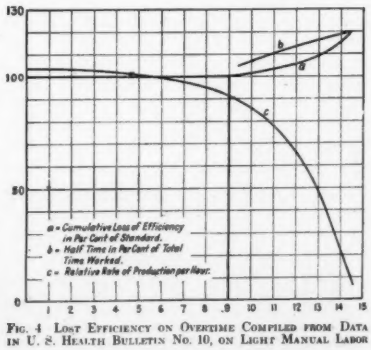

a = Cumulative Loss of Efficiency in Per Cent of Standard.
b = Half Time in Per Cent of Total Time Worked.
c = Relative Rate of Production per Hour.

FIG. 4 LOST EFFICIENCY ON OVERTIME COMPILED FROM DATA IN U. S. HEALTH BULLETIN NO. 10, ON LIGHT MANUAL LABOR

den for periods in excess of about 12 hours.

The policy of paying overtime on incentive rates, which has recently been adopted by the Atlantic Refining Company, is based upon the fundamental fact that efficiency declines very rapidly on overtime. Fig. 5 gives an analysis of the conditions and the plan of payment which has been adopted.

The advantages of this plant summarize as:

1. It compensates the 100 per cent efficient worker for the additional physical cost of overtime equally as well as the ordinary day worker.
2. It facilitates working incentive workers and day workers side by side on Sunday and holiday without dissatisfaction.
3. It promotes the health and well being of the working force by minimizing overtime on incentive plans.

CONDITIONS

1. Asked to work overtime and standard conditions not maintained on overtime.
2. Required to work overtime due to volume of work and all conditions maintained and men earn usual bonus.
3. Overtime caused by men failing to make usual efficiency.
   a. Through their own fault.
   b. Through breakdown or other cause beyond their control and are required to work overtime. Standard conditions obtaining.
5. Emergency calls at night, Sunday or holidays.
6. Overtime for incentive rate workers will be computed on the same basis as for hourly rate workers, in the departments and groups listed.

PAYMENT

1. Present overtime rules for hourly workers to apply.
2. Time-and-half for overtime daily or double time Sundays and holidays plus bonus. Piece rate plus ½ base rate for overtime daily or plus base rate on Sundays and holidays.
   a. Straight piece rate or bonus.
   b. Time-and-half for overtime daily or double time Sunday and holidays plus bonus. Piece rate plus ½ base rate for overtime daily or plus base rate on Sundays and holidays.
5. Time-and-half for overtime daily or double time Sunday and holidays plus bonus. Piece rate plus ½ base rate for overtime daily or plus base rate on Sundays and holidays.

INSTRUCTIONS RELATIVE TO OVERTIME

Payment of Overtime

The following instructions will govern the payment of overtime in those sections of the organization listed in this standard and all incentive plans approved after this date by the Rate Committee unless noted to the contrary.

PER CENT OF MAXIMUM OUTPUT

Hours	1 Muscular Labor	2 Heavy Labor	3 Light Heavy Labor
Maximum	95*	100	100
.5	90.8	97.4	100
1.5	95	100	99
2.5	92.9	87.3	98
3.5	92.7	69.7†	97
4.5	83.9†	95	92
5.5	93.5	83.3	86
6.5	89.3	74.9	
7.5	85	64.8	
8.5	82		
9.5	59.9		
10.5			
11.5			
12.5			

(1) Page 51—Public Health Bulletin No. 106
(2) Page 44—Public Health Bulletin No. 106 (Excavate).
(3) From Shepard Chart (Industrial Management, November, 1921)
*100 equals maximum possible, but maximum attained was only 95.
†Indicating the effects of fatigue prior to the lunch period. The next figure below indicates the effect of lunch. See Figure No. 2 for typical curve.

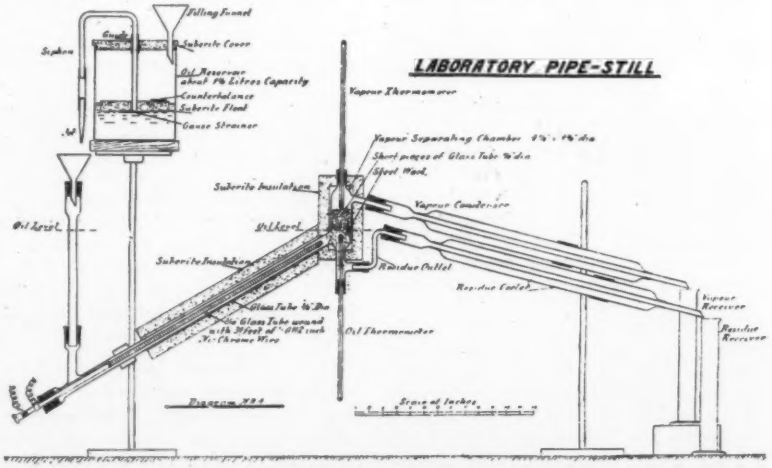
Continuous Distillation Temperatures of Vapor And Liquid Determined in Laboratory Still*

By A. A. ASHWORTH
Member M. A. A. M. Inst. C. E.

WHILE studying the design of pipe stills for continuous distillation in the refinery, it was manifest to the writer that the temperature range occurring in a pipe still distillation, where, as in the Trumble system, all the light oil vapors are taken off together, must be very different from that occurring in a bench of the usual type of shell stills; yet no records were obtainable from current literature from which the required information as to the magnitude of this difference could be obtained and no writer on the subject had even made the slightest reference to the point. The amount of the difference was difficult to calculate, but some not very direct calculations made by the writer indicated that the temperature at which the light oils were vaporized in a pipe still such as the Trumble would be some 80 degrees to 100 degrees Centigrade below the temperature necessary for the same distillation in the usual bench of continuous crude stills, the difference naturally depending on the distillation characteristics of the crude oil, a digerence sufficiently large to be of great importance when designing the residue and vapor heat interchangers which are essential parts in economic crude oil distillation and too great to be accepted without further proof.

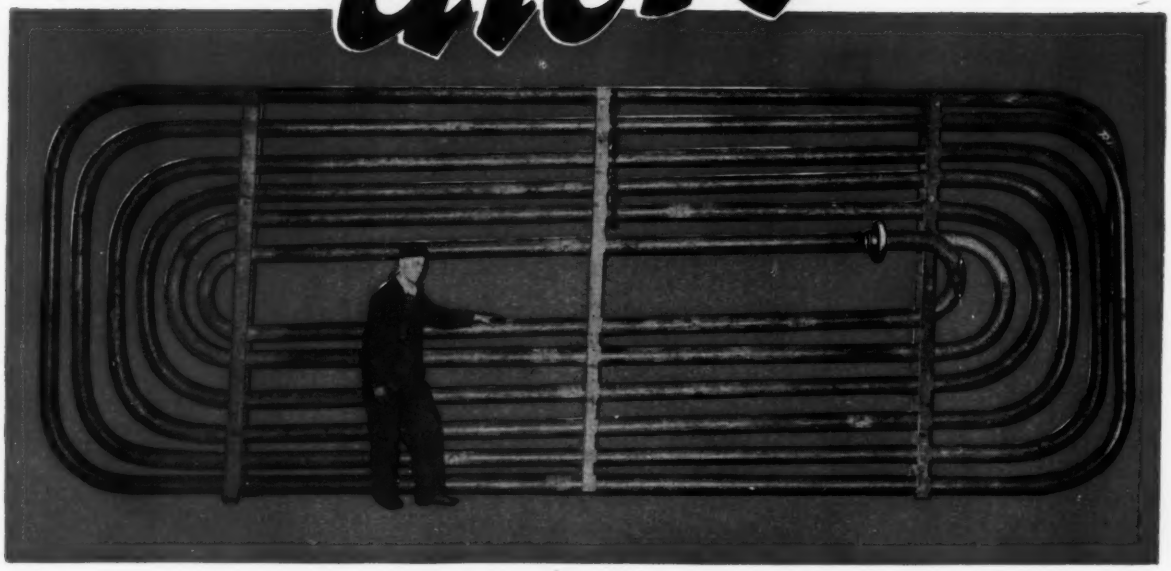
With a view to confirming the results arrived at by calculation, a form of laboratory pipe still was devised which has proved in practice to give reliable and consistent results and which may well be of use in other experimental work than that for which it was primarily designed.

The requirements to be met by the laboratory still were that it should be capable of continuously distilling the light oils from a crude oil up to a temperature of about 300 degrees Centigrade and with a rate of feed of from 7 to 10 cc. per minute. With this rate of feed, it would be possible to obtain a fairly full range of distillation temperatures and percent-



*Reprinted from the Journal of the Institution of Petroleum Technologists.

habitually *alert*



THE continuously welded pressure distillate condenser coil shown here is an excellent example of this Midwest characteristic—habitual alertness to better serve the users of fabricated piping. Previous to the time that Midwest began fabricating these coils, they were assembled from straight lengths of pipe, flanges and cast return bends.

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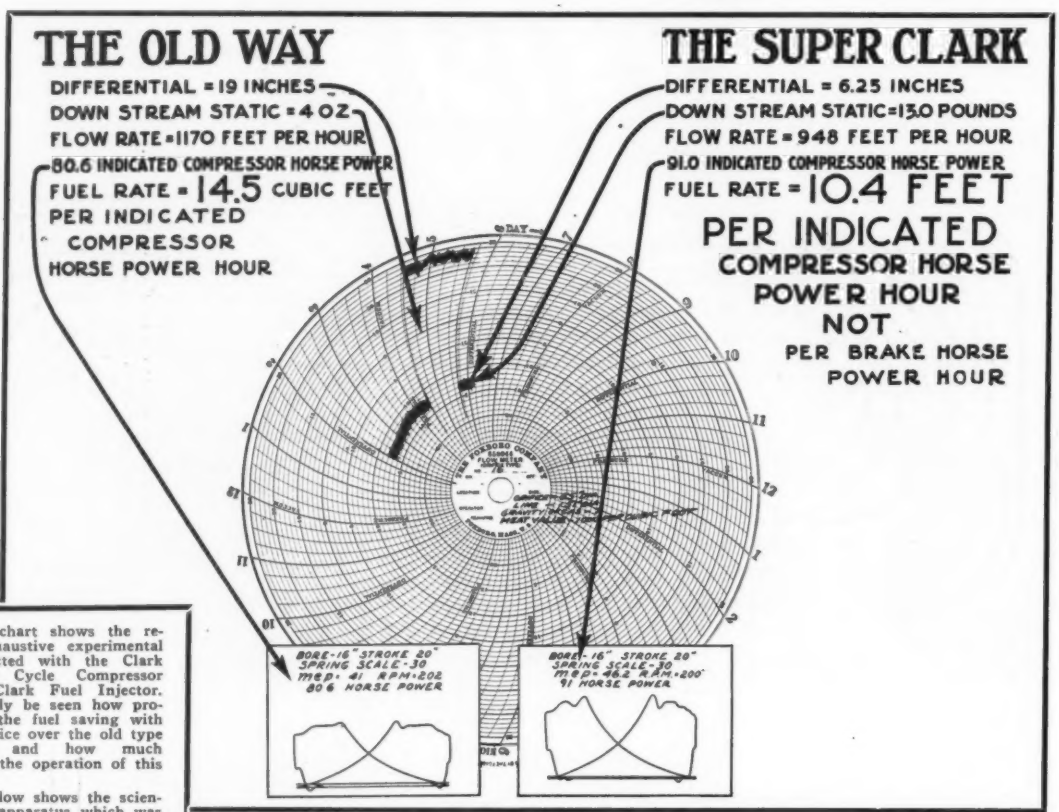
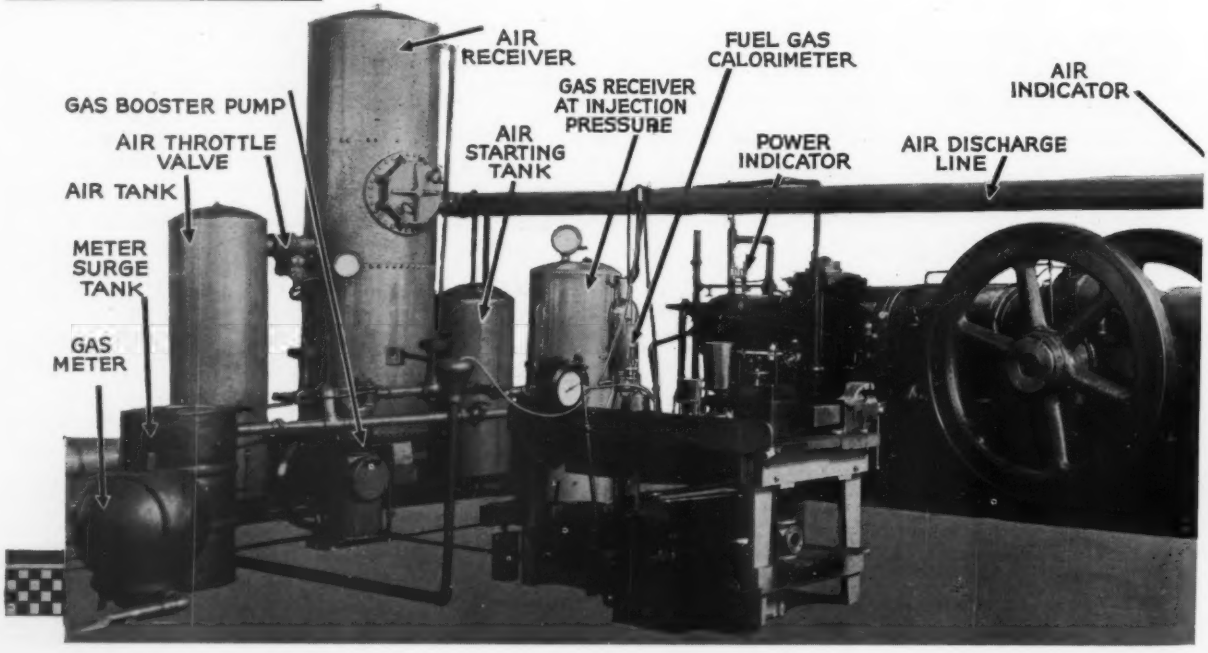


The above chart shows the results of exhaustive experimental tests conducted with the Clark Super "2" Cycle Compressor using the Clark Fuel Injector. It can readily be seen how pronounced is the fuel saving with this new device over the old type compressor and how much smoother is the operation of this compressor.

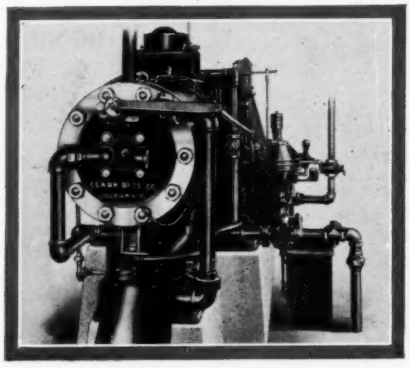
The view below shows the scientific testing apparatus which was used to record the operating data.



ted for 12 months

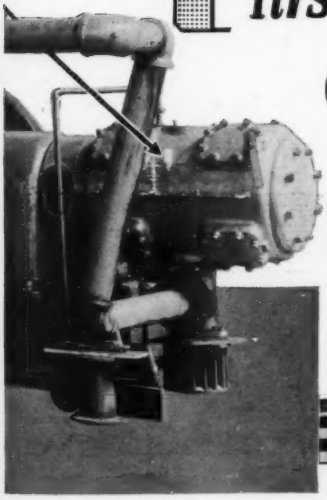
For more than a year we tested the CLARK FUEL INJECTOR with the CLARK SUPER "2" at our Olean factory. The results (opposite) show the greater fuel economy and smoother operation of this compressor.

A glance at the test set-up of the Clark Super "2" Compressor, opposite, is sufficient to suggest the thoroughness with which the Clark Fuel Injector was tested for operating facts. For more than a year this compressor was operated at our Olean plant, with the most scientific apparatus available, until our engineers were convinced of the perfection of this fuel saving device for obtaining greater fuel economy and smoother operation from the Clark Super "2" cycle compressor.



See the Super "2" at the Exposition, where it will be shown in connection with other Clark products. Several have been installed for leading gasoline manufacturers, where their remarkable fuel economy and consistently better performance have already marked them for further popularity. Clark Bros. Co., Olean, New York. Branch and Mid-Continent warehouse at 125 W. First St., Tulsa, Okla. Warehouses at McCamey and Sweetwater, Texas, and Artesia, N. M. Also Smith, Booth, Usher Co., 228 S. Central Ave., Los Angeles, and 50 Fremont St., San Francisco.

The CLARK exhibit at the Petroleum Exposition offers an opportunity to study at first hand the following CLARK products:



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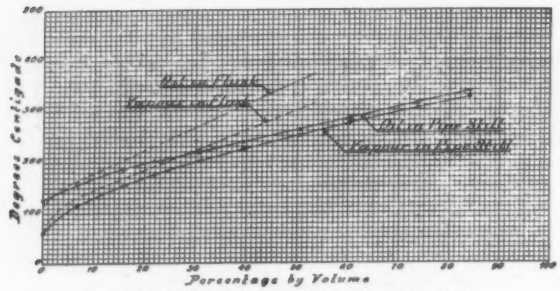

Diagram 2—Distillation of Pennsylvania Crude. Sp. Gr. 0.815.

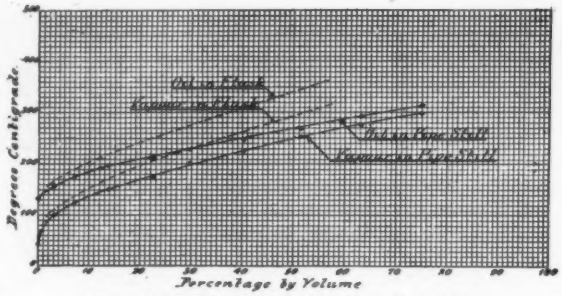

Diagram 3—Distillation of Mid-Continent Crude. Sp. Gr. 0.835.

ages without using up an inconvenient amount of crude oil. It was also essential that the temperatures of both oil and vapor should be obtainable with considerable accuracy.

The design arrived at is shown in Diagram No. 1.

The crude oil is fed in at the desired rate into the funnel shown and fills the vertical tube to a point high enough to maintain the flow through the rest of the apparatus. From this vertical tube it enters in the inclined tube in which is inserted an electric heater. The internal diameter of the inclined tube is five-eighths inch. The electric heater consists of a one-fourth inch external diameter tube extending the full length of the inclined tube and through which passes one lead of the electric circuit. The outside of the one-fourth inch tube is wound with 31 feet of 0.012-inch diameter nichrome wire having a resistance of 5.2 ohms per foot at atmospheric temperature and 5.5 ohms per foot at 300 degrees Centigrade. This heater was designed to use with a 220-volt D. C. circuit and was proportioned to pass a current of about 1.3 amperes at 300 degrees Centigrade.

From the inclined tube, the oil and vapor enter a separating chamber which is one and one-half inches in diameter by four inches high in the body. At the top of the chamber is a neck through which the thermometer for taking the vapor temperature passes and at the bottom another neck through which passes the thermometer for taking the oil temperature and from which neck the undistilled oil passes by means of a bent tube to the Liebig condenser which serves to cool the oil on its way to the graduated measure which ultimately receives it.

The vapors leave the chamber by the upper branch and are condensed in a Liebig condenser and delivered to another graduated measure.

The body of the separating chamber is filled with one-fourth inch glass beads resting on a small support of steel wool to just below the level of the bulb of the upper thermometer. These beads serve to prevent oil from foaming up in the chamber and reaching the vapor thermometer and vapor outlet.

Contact Maintained

The level of the oil in the chamber is kept at the desired point by the dimensions of the siphon tube through which the residue passes to the cooling condenser.

With this arrangement, the vapors are kept in continual and intimate contact with the oil so that equilibrium can be attained and the temperatures of both oil and vapor are measured immediately after separation. It is important that these two conditions be realized in order to give conformity with the conditions in a commercial pipe still. In the laboratory apparatus it is comparatively easy to get the oil temperature correctly, but the vapor is very speedily affected by radiation losses and, in earlier attempts where these losses were not sufficiently guarded against, results obtained showed considerable discrepancies. With the arrangement shown, the discrepancy disappears and there seems no difficulty in duplicating results. The separation between the oil and vapor seems very complete and the distillates obtained showed an unusual absence of color.

The separating chamber and the inclined tube containing the heater are well insulated by "suberite" or compressed cork casing. Between the glass and the suberite a layer of asbestos is advisable to prevent charring at high temperatures.

In order to obtain consistent results, it is necessary that the oil should be fed to the still at a constant rate. The arrangement shown in Diagram No. 1 has proved satisfactory for all but very viscous oils. In this arrangement, the oil is contained in a glass vessel of capacity about 1 liter. On the oil there is a suberite float which must be well sized to prevent is becoming oil soaked. The float carries a siphon by means of which the oil is conveyed to a glass jet of size suitable for the desired rate of feed. The jet being attached to the siphon by a short length of rubber tube, the vertical head between the point of the pet and the level of the oil in the container can be adjusted which provides a second means of adjusting the rate of feed. The container is covered by a suberite cover through which passes a funnel for filling and a short length of glass tube to act as guide for the vertical leg of the siphon. The float must be carefully counterbalanced so that it maintains a substantially horizontal position, thus avoiding friction in the guide tube and it is advisable to protect the lower end of the siphon tube with a gauze strainer.

Operating Method

The method of operation is as follows:

The apparatus having been filled with oil, which takes about 150 cc., the oil feed is started and the current turned on through a rheostat and an ammeter in the circuit. The initial current for a feed of 10 cc. per minute should be about 0:5 ampere.

With this current, the temperatures of the oil and vapor in the container rise gradually and, with average light crude oil, will gradually reach the initial boiling point which can be observed in the usual way by the first drop of distillate falling from the vapor branch of the chamber. By suitably adjusting the rheostat, the temperature of the oil and vapor can be

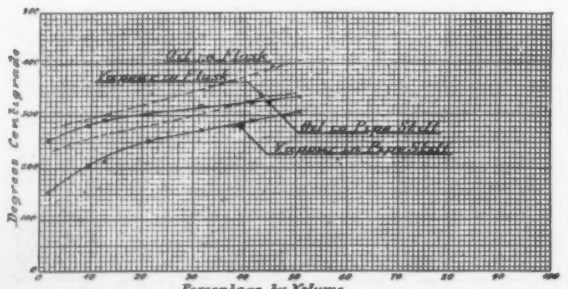

Diagram 4—Distillation of Gulf Coast Crude. Sp. Gr. 0.923.

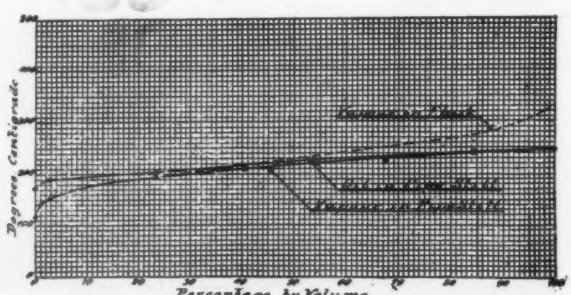

Diagram 5—Distillation of Commercial Kerosene.

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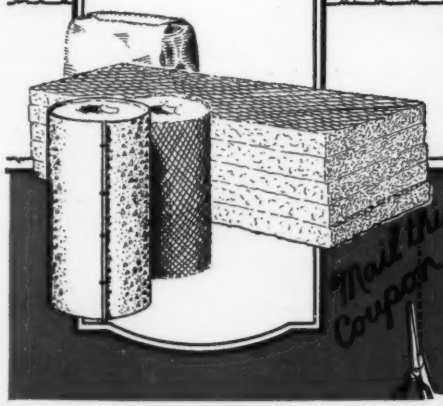

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stabilized at the required intervals of temperature, say about 25 degrees Centigrade. While the temperatures are held steady, the amounts of distillate and residue are measured in the respective receivers and by this means the percentage of oil distilled at any desired temperatures of oil and vapor calculated.

It is advisable to run off about 100 cc. of residue or distillate at each point of observation. Smaller amounts would tend to inaccuracy, and it is also important that the temperatures at the beginning and end of each observation should be the same. The effect of any small variations during an observation can be minimized by taking the mean temperatures without introducing serious error so long as these variations do not exceed two degrees or three degrees Centrigrade. With careful working, it is quite possible to keep this variation well below two degrees Centigrade.

Three Crudes Used

Three different crude oils were distilled in this apparatus, and the results compared with the distillation of the same crudes in a flask fitted with thermometers for taking the temperatures of the vapor and residual oil.

The curves shown on Diagrom No. 2 give the comparison in the case of a Pennsylvania crude oil.

It will be noticed that the initial distillation temperatures of oil and vapor were sensibly the same in both flask and pipe still, but, as temperatures rose and the proportion of distillate increased, the pipe still temperatures fell considerably below the temperatures for the same percentage distilled in the flask.

With 50 per cent distilled, the oil temperature in the pipe still was 95 degrees below and the vapor temperature 50 degrees Centigrade below the corresponding flask temperatures.

The distillation curves shown in the diagram enforce attention to one other salient difference between the flask and pipe still distillations. In the flask, the difference between the oil and vapor temperatures is seen to increase as the temperatures rise, whereas, in the pipe still, this difference decreases. This is, of course, due to the fact that vapor temperatures as taken in a ffask distillation are not the temperatures of the vapor as it leaves the oil, but the eemperature of the vapor after it has been cooled considerably in rising from oil surface to the vapor outlet. This cooling is naturally greater as the temperature of the vapor rises and more heat is lost by radiation. It is very difficult to observe in flask distillation the real difference in temperature between the oil and vapor as it leaves the oil. Various arrangements of flask distillation have been proposed by Young and Brown and other chemists, in order to observe this temperature difference more accurately, but the writer is of opinion that none of these arrangements approach the pipe still here described in accuracy.

From the point of view of the engineer, who has to design distillation plant with its necessary adjuncts of residue and vapor heat interchangers, it is important that the difference of temperatures between oil and vapor should be known with fair accuracy. There is at present no known method of calculating this difference. It would probably be necessary to do some research work on the mean molecular weights of residue and distillate at various percentages distilled for each oil in order to obtain the necessary data for such calculation, but without such work the pipe still described would seem the only available method of getting the necessary information.

Diagram No. 3 shows similiar results in the case of an average Mid-Continent light crude oil and No. 4 in the case of a Gulf Coast crude.

Comparisons

In this last case, however, there is one noticeable difference in that the initial boiling points in flask and pipe still are not the same. This was due to the crude oil containing a substantial amount of water which actually prevented the accurate observance of the I. B. P. in the flask.

Comparing the diagrams for the Pennsylvania and the Mid-Continent crude oils, it will be seen that the lowering of the temperatures was rather less in the latter than in the former. This was due to the Pennsylvania crude containing a rather larger percentage of light distillates.

In pipe still distillation where all the vapors are kept in contact with the oil while the light oil distillates are taken off, the lighter vapors act as "propellants" in the distillation of the heavier vapors in the same way as steam does in distillation in shell type stills. This is a very strong argument in favor of taking off all the vapors in a single pipe still as in the Trumble plant, instead of following what seems to be the prevailing tendency of reducing each of the usual shell stills of a continuous bench with a separate pipe still and pumping the residue from each separate pipe still through the next in the series. If a single pipe still is used distillation can be carried much further if desired without fear of cracking as can be seen from either Diagrams No. 2 or No. 3. Diagram No. 2 shows that Pennsylvania crude could be distilled up to about 80 per cent off without steam and without fear of cracking taking place.

Diagram No. 5 illustrates one further pipe still distillation, namely that of a commercial kerosene. In this case the vapor temperatures only were taken in the flask distillation. Here, again, the initial distillations in the flask and the pipe still are seen to be coincident, but pipe still temperatures are considerably lower as greater percentages are taken off. The final boiling point in the flask was 325 dgrees Centigrade, with 99 per cent distilled, and in the pipe still 245 degrees Centigrade with 100 per cent distilled. In the pipe still there was no heavy residue left, and it is interesting to note that the final temperatures of oil vapor were the same.

The final temperature could be observed with considerable exactitude as, when the temperature rose slightly too high, the level of oil in the still sank slightly below the highest point in the bent residue tube, and continued to fall, showing that not only was all the oil fed to the still evaporated, but the oil remaining from the previous portion of the distillation was being carried over also. If on the other hand, the temperature fell a degree below the final boiling point, the level of the oil in the residue tube slowly rose again and a very small percentage of residue again dropped from the residue outlet.

The pipe still can thus be used for observing the equilibrium temperatures of light distillates, and these equilibrium temperatures have recently received a certain amount of attention in America, where it has been proposed to use the equilibrium temperatures of gasoline as a standard test of their quality. This example shows that it is possible to redistill a light oil distillate completely in a pipe still with 100 per cent recovery, whereas it would be impossible in a shell type still.

The distillation of oils containing a fair percentage of water can be carried out comparatively easily in the still so long as the vapor temperature is above 100 degrees Centigrade so that water does not condense in the upper part of the separating chamber.

It may be of interest to note that the thermal efficiency of this apparatus, even when distilling up to a temperature of 300 degrees Centigrade, is over 50 per cent.

The writer's thanks are due to the authorities at the Royal School of Mines for the permission to conduct the above experiments in the laboratory there.

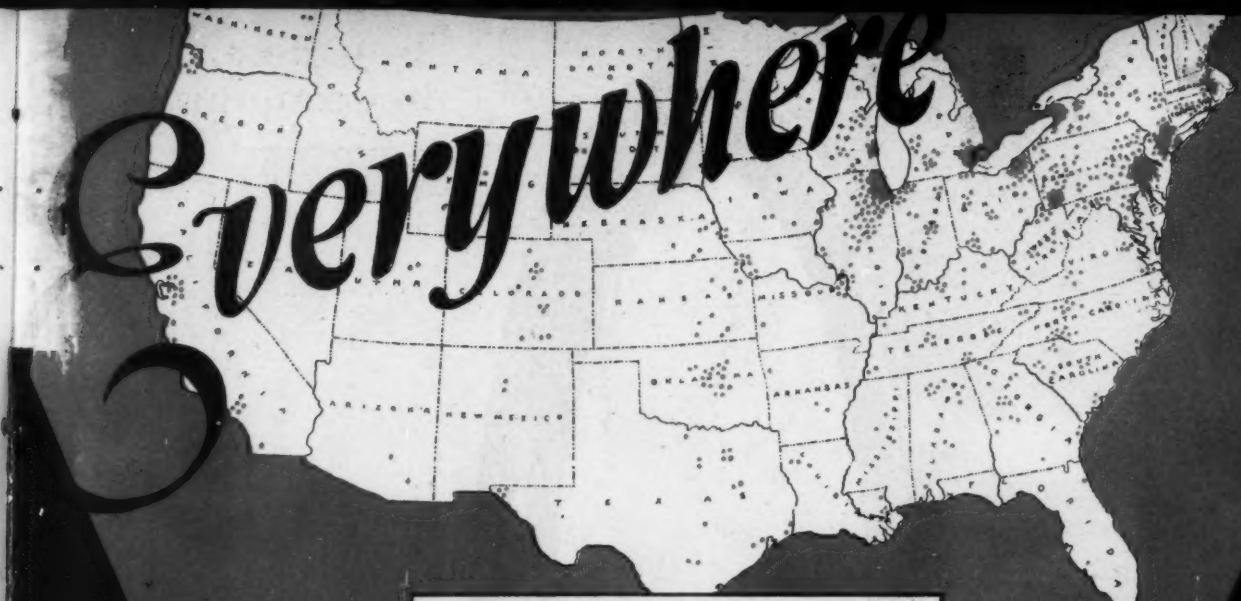
Colorado Plant Starts

Denver, Colo.—Mountain States Gasoline Corporation has begun operating its absorption gasoline plant on the Garcia Dome in Las Animas County. The new plant is of the Campbell Oil Froth type throughout, and was constructed for the operating company by the Campbell Engineering Company of Long Beach California. The plant is operating on the gas production from four wells in sections 3 and 4-34-62. Analysis of the gas indicates a gasoline content of 2.2 gallons per thousand cubic feet.

Double Capacity

Shreveport, La. — The Dixie Oil Company is installing additional equipment at its Gillian, Louisiana, absorption gasoline plant which will result in the doubling of the plant capacity. This plant is of the Newton type throughout, and when completed will operate at 500 pounds pressure, handling around 60,000,000 cubic feet of gas daily, with an estimated extraction production of 20 to 22,000 gallons of gasoline daily.

Everywhere



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New Developments In Petroleum Manufacture

By T. G. DELBRIDGE
Atlantic Refining Company

WHAT constitutes an improvement depends upon immediately preceding knowledge or experience. To the starving man, mouldy bread is a wondrous repast. He who has always driven a four cylinder car, marvels at the smoothness of his new six. So with methods of refining petroleum, an improvement is strictly comparative as referred to past practice. You will, therefore recognize that no one person can be familiar with just what has been or is being done by all refiners, many of them actual or potential business competitors. The present paper makes no pretensions at presenting in completeness or with guarantee a compendium of the latest models of refining appratus or method. It is merely a recital of development which seems worth while from the viewpoint of one individual. Certain it is that much of what follows is well known to all of you; possibly all of it is old to some of you. If, in the course of the review, a few profit by direct information or by suggestion, my purpose will have been fulfilled.

Regardless of the line of products we manufacture, or of the kind of crude petroleum we run or of how we market our output, we have one common aim—namely, to operate at a profit. True it is that all too often this aim is temporarily forgotten by the operating force in an effort to meet a promised delivery date, to produce a special desired quality of product or to correct some temporarily embarrassing predicament. As the first instance of refining improvements, I submit the growing tendency on the part of operators to subordinate other considerations to the basic purpose of profitable operation. There is still room for great advance along this line, but that which is the paramount issue in the minds of you who are owners and managers can, by judicious supervision, explanation and perseverance, be indelibly impressed upon your subordinates down to the most humble employe. These present adverse times cannot fail to lend emphasis to the prime importance of intelligent action by every man on the payroll. The human factor can be greatly assisted and augmented by mechanical device—it can never be displaced. It is the greatest single factor in refining operations; it has been improved; it can be improved further and the effort expended in that direction is likely to give large and quick returns.

Evaporation Losses

We have a second universally common interest in that we all operate on raw material which misses no opportunity to disappear through evaporation.

Evaporation losses from gasoline and naphthas are even more readily encountered, since it is this very property which gives these products their high place in commerce. This subject has been covered so often that mere mention would be sufficient, were it not for the fact that in this case as often "familiarity breeds contempt." We have always had evaporation, we have always known about it in a way. As the second instance of improved refinery practice, I cite the various methods of reducing and even substantially preventing evaporation. The manufacturers of equipment have covered the field so well that no elaboration is required. Post card inquiries will bring you reams of literature showing that the elusive naphtha vapor cannot get away from you if you use a floating roof, or it may be an insulated deck, or pressure storage, or breather balloons, or other device. All these have merit; which one is best for you depends upon your individual needs and possibly on your pocketbook. Even small leaks in roof seams of naphtha tanks are important and should be caulked with a suitable plastic compound not acted on by naphtha. Apparently tight seams frequently show leaks when tested with soap solution.

Before leaving this subject it seems wise to remind you that evaporation losses are serious not only in storage but particularly in the movement of crude petroleum and its more volatile products. Working tanks, pumped or flowed frequently should not be overlooked.

Out of the immense volume of data now in print on the subject, one fact is well worth remembering: 1000 cubic feet of gasoline saturated air at 90 degrees F. contains 15 gallons of the most valuable part of the gasoline. At 15 cents a gallon this means $2.25 per 1000 cubic feet. Compare this $2.25 with the price of 1000 cubic feet of manufactured gas! Remembering that a cube 10x10x10 holds 1000 cubic feet and that a 10,000 gallon tank car contains over 1300 cubic feet, it is easy to understand how profits evaporate.

Speaking of tank cars, gasoline loading operations should be carefully reviewed by each of you. I realize that you all know how to load, but my question is "Do you do it that way?"

Some months ago, a refinery somewhere in Pennsylvania was found to be loading motor gasoline with an overhead line ending in the dome. The extension lines for loading lay unused on the rack. The loss per 10,000 gallon car loaded at 95 degrees F. was found to be 24 gallons. By installing a permanent counterweight loading line ending in a tee that could rest on the bottom of car, this loss was reduced to five gallons per car. A description of this particular device will appear shortly in one of the technical journals.

At this point a digression is made for the purpose of emphasizing that what we think we know is often inadequately interpreted. The question to be propounded is a straightforward one with a definite answer, which answer most of you will not even approximate. It is this: Given a solid spherical ball of ordinary cork—the kind used to cork or rather uncork a bottle—and supposing this cork ball to have a diameter of 15 feet, how many pounds will it weigh? We are all familiar with the nature of cork and recognize that it is light. Your answer if you are an average individual will be about 100 pounds. The correct answer is about 28,000 pounds—14 tons. The purpose of this interlude is to impress on you the danger of guessing even when you think you have a fair basis for the guess. So with evaporation losses, don't guess. Measure or calculate or both. Make sure that you know the proper remedies and above all be sure that the application of these remedies is carried out in fact and not merely in your fancy.

Distribution of Costs

Passing on to processing operations, your attention is called to an approximate general manufacturing expense distribution, namely:

Fuel, Stills and Boilers	40 per cent
Process Labor	20 per cent
Maintenance	15 per cent
Chemicals, Clay, etc.	15 per cent
Sundry	10 per cent
	100 per cent

Costs in different refineries will vary somewhat from these figures, depending on kind of crude, nature of end products, size of plant and efficiency of operation. Except in very abnormal cases, the figures given are believed to convey a correct idea of the average present manufacturing expense. They portray in striking manner the overshadowing importance of fuel costs. Your association, during the last two years, has wisely devoted much attention to the matter and you are, or should be, well informed as to improved methods of utilization, and therefore conservation of fuel. Still fuel efficiencies of 30-35 per cent are not so

*Paper read before the Twenty-fifth Anniversary meeting, National Petroleum Association, Atlantic City, September 16, 1927.

far in the past that they seem strange. The standard for today is 65-70 per cent, with more than a hope of reaching 75 per cent, now standard for boiler practice in the refinery. Such improvement is due mainly to the design of furnace and of heated surface, to increasing utilization of radiant heat, to heat exchangers and economizers, to the adoption of continuous processing and to constant control of combustion. The last factor is increasingly important. Fortunately, instrument makers are at our service with reliable indicating and recording meters for temperature, pressure, volume, CO_2, etc. Ignorance of furnace and still conditions is no longer an adequate excuse for poor firing. We in this part of the country have not failed to take advantage of coal as fuel. Under ordinary conditions, coal, hand-fired, is ultimately more expensive than low grade fuel oil. The use of suitable stokers properly installed and operated has in general reversed that condition. The use of pulverized coal, now firmly established in other industries, is just beginning to find its place in the refinery. One of the Eastern companies has recently made four installations of powdered coal on pipe stills. Preliminary results are promising and there is abundant reason to believe that this method of heating will become popular, not only because of its easy control, but also because the change from coal to oil or gas can be made practically instantaneously.

The better use of radiant heat may well be considered a distinct advance in petroleum distillation. Not so long ago the rate of heat input through the still bottom was only 6000 B.T.U. per square foot per hour. Today 25-30,000 is a rate not uncommon in pipe still practice. Excellent results have been obtained by more or less completely surrounding the source of radiant heat with tubes. This principle is applied in a unique and novel manner in two stills now in course of construction. The results are expected to have a profound effect on future heater design.

Insulation

Another instance of improvement is in heat insulation. Heat, like gasoline vapor, misses no opportunity to migrate and disappear without contributing its share to that profit which we want and must have. Excellent heat insulating materials are now manufactured specifically for our industry. Any manufacturer of these materials will gladly tell you how much you can save by installing the right kind—his kind—of insulation. He is almost certain to be right but—insulation, like heat and like gasoline vapor, is prone to wander from its proper place, unless applied with unusual care and maintained with very unusual diligence and vigilance. If you have any doubt as to the accuracy of the words "very unusual," an inspection of insulation in your own refinery is prescribed. The results from this prescription are usually beneficial, except in fatal cases due to shock at seeing the actual condition.

Insulation to retain cold is even more important than that to retain heat. It costs twice as much to make ice as it does to make the same weight of steam. Perhaps the outstanding recent development in wax distillate pressing is the realization that effective insulation is always profitable and often indispensable to satisfactory operating results.

The second largest item in refinery manufacturing expense is labor. Refining methods are dependent on both quality and quantity of labor as on no other single factor. It is not surprising, therefore, that the proper utilization of labor is receiving intensive study and with resulting improvement in refinery operation. Piece rates, the group bonus and similar systems, when soundly conceived and equitably administered, are rapidly increasing in popularity, with men as well as management. The interest and enthusiasm of process operators is being stimulated in many ways. While time will not permit further comment, this subject is urgently recommended for your careful consideration.

Up-to-Date Stills

Distillation, as the most important process in petroleum refining, has been studied and developed to a high degree of efficiency during the last three years. The three outstanding features of development are continuous coil heaters, fractionating columns and the application of vacuum.

Among the advantages of the up-to-date pipe still are the following:

Saving of rerunning; whereas in 1923 the average complete lubricating refinery actually charged into still about 2.7 barrels for every barrel of crude run, with the pipe still this is cut to 1.5 barrels, or even less.

Saving in fuel; the fuel required for the crude distillation alone is about 65 per cent of that used for corresponding batch distillation in shell stills. Savings in steam are of about the same order of magnitude.

Complete recovery of the more valuable products, conspicuously gasoline. A modern bubble tower properly operated gets all the gasoline existing as such in the crude. Similarly lubricating oil yields may be increased by 50 to 100 per cent on the finished oil basis, depending on kind of crude and former method of running. It should be noted that the quality of high boiling products from the pipe still is appreciably better on account of the short time of exposure to high temperature. This is reflected in subsequent refining operations. It is possible to go to lower bottoms than can be done in batch shell still practice. Runs of Mid-Continent type crude to 8 per cent bottoms are common.

Reductions in labor, in ground space, fire hazard are other advantages of pipe-stills. In one refinery labor and ground space covered are only 25 per cent of the corresponding shell still figures.

The use of high vacuum stills is increasing. By high vacuum is meant absolute pressure less than 10 mm., or a half inch of mercury. While a number of installations of the batch shell type vacuum still are operating successfully, it is highly probable that these cannot compete with a continuous still, preferably of the coil type. While most vacuum distillation has been carried out heretofore on the relatively low boiling naphthenic crudes, nevertheless this method has a real application to some products from paraffin base crude, even Pennsylvania. The advantages of high vacuum distillation are usually given as larger yield and better quality of product, but it is reasonably certain that direct and indirect fuel savings are equally important. Rapid development of vacuum distillation is predicted.

Improvements in Cracking

Improvements in cracking have taken place along several lines; increased throughput of stock and increased output of gasoline per unit by better utilization of heat and increased heating surface is a major improvement on the heat pressure systems as is the greater flexibility as regards charging stock. The use of aluminum chloride for cracking now appears to be commercially successful and important. Vapor phase cracking is no longer experimental. Several plants using this method are in operation and others are in course of construction. In view of the immediate importance of the detonation characteristics of gasoline, vapor phase cracking would seem destined to hold an important place.

Since gas production of the refinery is increased by cracking, particularly at low pressure or in vapor phase, the problem of utilizing this gas is receiving study in many quarters. While commercial solvents such as alcohols, ketones and esters are now being produced from refinery gas in small yield, there is reason to believe that complete conversion of this gas into motor fuel is not impossible.

The use of fine clay or fuller's earth for decolorizing is another development that has a real place in most refineries. This so-called contact process, in my opinion, will supplement percolation through clay, but will not displace it. The advantages of contacting with fine clay appear to be very marked over acid treatment of distillate lubricating stock. A light acid treatment of such stock followed by fine clay gives decidedly more finished oil, the increased yield representing about 95 per cent of the increased profit over acid treatment alone. In this connection, it should be remembered that as the demand for fine clay increases, its price will increase and approach that of 30/60 mesh earth. Its recovery and re-use will then present another refining problem.

Mention is made of the increasing use of clay burning equipment of the Herreschoff and Wedge type. Its popularity is justified because the regenerated clay has a decidedly longer life than that burned by the conventional rotary kiln and at least some of the gravity flow type.

The Edelanea method of refining by extraction with liquid sulphur dioxide is widely used on the Pacific Coast. Kerosene so prepared from California crude is competitive in quality with the best made from Pennsylvania or West Virginia crude. The use of the liquid sulphur dioxide process in Eastern refineries has not been imperative, and, therefore, the high initial cost of the installation and the considerable royalty have reacted

(Continued on page 106)

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By H. N. BLAKESLEE,
Field Representative, Petroleum Division, National Safety Council

THE American Petroleum Institute in its desire to assist the petroleum industry and to maintain the ideals of its members has considered it proper to sponsor an organized effort to prevent accidents to petroleum workers. The National Safety Council, a non-profit association with a membership of over 4000 industrial concerns with service reaching over 8,000,000 employes, and with 14 years experience in helping the industry to solve its accident prevention problems, was selected to direct this organized safety campaign in co-operation with petroleum companies throughout our nation.

Already existing within the National Safety Council Industrial Division is a Petroleum Section. This section, which has been functioning for six years, is an organization of the accident prevention men of a number of leading companies in the petroleum industry. Committees have been organized representing petroleum companies of the Atlantic Coast, the Pacific Coast, and the Mid-Continent areas. With this organization already functioning, it is entirely logical that the American Petroleum Institute should sponsor a full time representative through the National Safety Council to promote still further the prevention of accidents to workers in the petroleum industry.

The National Petroleum Association has promoted an exceptionally splendid fire prevention organizatioin within its membership. Fire prevention work is primarily for the protection of property. Accident prevention work is for the conservation of human energy and the protection of human lives. Nevertheless, fire prevention and accident prevention have much in common, making it difficult, if not impossible, to establish a dividing line between the two. By removing fire hazards and by controlling fires in their incipiency you have not only saved valuable company property but you also have eliminated the exposure of workmen to hazards which might have caused injury or loss of life.

Furthermore, causes of fires and accidents are in a manner synonymous. Fires are caused either by an act of God, by mechanical or chemical action or by human carelessness or lack of foresight. Accidents come about through similar causes, an act of God mechanical failure, or human failure. It is quite evident that work done along the line of fire prevention, with little additional effort can be extended to cover accident prevention. This is especially true in small organizations where the fire marshal or fire prevention engineer may add accident protection to his other duties. In the larger organizations where operations are spread out over a greater territory, it is frequently advisable to have both a fire prevention engineer and an accident prevention engineer.

Why Safety Work

Various employers have asked this question: "Why should I start safety work in my plant? I don't have many accidents and when I do have the insurance company pays the bill. So what would I gain by spending money and time in trying to prevent accidents?" Insurance companies admit they are in business to make money and whenever your accident experience becomes so bad that you are a loss to your insurance carrier the rate of your insurance premiums will be raised or the insurance carrier will drop you as a bad risk. You are actually paying your accident costs although you are insured.

Accident prevention is a humanitarian necessity. We must not contribute to situations which cause the loss of time and suffering to our fellow men. In Pennsylvania a lost time accident pays nothing for 10 days, after which time the workman draws a maximum of $12 per week as long as the disability may last. It is depressing to all of us to know that an injured fellow workman is at home suffering and trying to maintain his family on $12 per week. We feel this situation most keenly when we realize that it was probably within our power to have prevented this accident.

Accident prevention is not only a humanitarian necessity, it is also a business investment—an investment that pays dividends. When an accident occurs something has gone wrong. If the accident has been to machinery, usually the machine stops and production stops. If an injury has been to a workman, usually the injured workman and all those working around him stop work and frequently the machine is stopped. Whenever workmen or machinery stop, production ceases, but production costs continue, and when production costs go on without production, dividends or earnings suffer. About two months ago one of our companies experienced the following accident: A hammer driver, while waiting on a heat, sought to amuse himself and others by throwing water through a window on a clerk in the office adjoining the shop. The clerk, in order to retaliate, rushed into the shop. The hammer driver, to protect himself and to carry the game further, ran to a hydrant, expecting to turn the hose on the clerk. The clerk grabbed what he supposed to be a bucket of water and threw it on the hammer driver. The bucket contained gasoline. The vapor was ignited from the burning forge and the hammer driver was turned into a human torch. The hammer driver died from his burns. The clerk who threw the gasoline and one other man were severly burned in putting out the fire. The costs of such an accident from the standpoint of claims covering hospital, medical bills and compensation, are large, but are not the only costs. Naturally every workman in the vicinity of this accident rushed to the scene. Lathes stopped. Forges were shut down. The whole office turned out. Other jobs stopped. Production was at a standstill with costs going on. After such an accident how long does it take crews to get back to normal production after they have actuallly once more resumed work? What is the condition of the nervous system of these workmen? Can they turn out the usual good products? It is impossible for us to actually figure the cost of lost time for such an accident.

The claims cost represent but one-fifth of the actual cost. This conclusion has been reached by Mr. Heinrich, of the Trevelers Insurance Company, in a recent study of 5000 accident cases. Some of the factors taken into consideration by Mr. Heinrich are cost of lost time of the injured employee, cost of time lost by other employees who stop work to assist the injured employee out of sympathy and out of curiosity, cost of time lost by foremen or supervisors in assisting the injured employee, investigating the cause of the accident, arranging for the injured employee's production to be continued by some other employee or replacing

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the injured employee with a new man, clerical work incident to the accident and other causes which we cannot dispute as being influential in running up production costs. Our conclusion, after reading Mr. Heinrich's article, "The Industrial Cost of Accidents," which covers his study, is that Mr. Heinrich has been very conservative in his conclusion.

Profits

The accident prevention thought has resulted in the development of many efficient methods and tools in the petroleum industry. It was told to me in a small refinery in the Mid-Continent area that a year ago the refinery was losing money. A new superintendent took charge of the refinery. He cleaned the property up, eliminated leaks and practices which were creating hazards, organized his force for fire and accident prevention work, and the refinery is now making money even under the present adverse market condition. Incidentally the refinery is operating with a smaller working force than it had before. Invariably, high accident costs accompany high production costs.

In the oil fields the desire to protect workmen has brought about such new devices as safety elevators, safety rod wrenches, and the clutch or automatic cathead. These all help to speed up the work. The clutch or automatic cathead removes the workman entirely from the dangerous position on the cat line when breaking the drill pipe and leaves him free to assist the rest of the crew around the rotary table on the slips and the tongs. A contractor has said that this new cathead has speeded up operation at least 25 per cent and will pay for itself in drilling one well. Workmen who are working with the accident prevention thought are better producers, are happier on the job and are more permanent employees.

The petroleum industry as one of our national leaders must build up the reputation of being a safe industry, so that the more progressive youth of the country will turn to it for livelihood and a future, rather than shunning it on account of its dangers.

All oil operators should give special attention to accident prevention, for they are obligated to protect the workmen, to reduce human suffering, to reduce claims costs, and last of all, but not least, to reduce production costs.

Good Management

Accident prevention is a part of and can be accomplished through good management. Management must establish safe working conditions and then develop safe workmen. There is a refinery in Western Pennsylvania where it is practically impossible to look around without seeing one or more No Smoking signs. The superintendent of this plant says that these signs don't mean **maybe.** He himself quit smoking in order that he might be able to set a good example for the workmen about the refinery. During the earlier part of 1927 this refinery experienced nine accidents over a period of five weeks. The superintendent analyzed these accidents with the conclusion that eight were caused by acts of workmen. This plant has been provided with reasonably safe working conditions and the superintendent is in a position to demand of the employees that they work more safely. The superintendent called this situation to the attention of the workmen ot the refinery and explained to them that men who could not work safely under safe conditions were not desired in that plant. As a result, the refinery has gone some months without a single accident. Accidents do not happen to safe workmen under safe working conditions.

It is regrettable that all plant managements have not provided these safe working conditions so that their superintendents can demand that men work safely. A superintendent who will quit smoking so as to set a good example for his men and provide safe working conditions and who takes a specific interest in the cause of accidents, shows without a doubt that he has the best interest of his company and the workmen at heart.

Safe workmen are made by developing in them the foresight which causes them to avoid injury. This is done through safety posters, first aid training, investigatioin of accidents and the evident interest of the management.

Posters placed regularly on the bulletin boards serve to keep interest ever present in the minds of the workmen and show them how to avoid certain accident hazards. Posters made from photographs taken in your own plant can be used to show how a woman was injured by his own act.

First Aid Training

First aid training has proved itself as a means of accident prevention. When a workman knows what an injury is, knows how to take care of it and the consequence of neglecting it, he is more thoughtful about avoiding injury. Thousands of dollars are saved annually by oil companies in death compensation settlements through the use of artificial respiration alone. Case after case is on record where men overcome by petroleum vapor and apparently not breathing have been resuscitated by fellow workmen. The United States Bureau of Mines has done a wonderful work in training oil workers in first aid. Wherever a suitable class can be arranged they have been furnishing first aid instructors free. First aid kits and men trained in first aid are to accident prevention as a fire extinguisher and the trained fire fighter are to fire prevention.

Thorough investigation of every accident, determining the cause and placing the responsibility makes workmen more thoughtful and careful. I am told that a man was killed in Western Pennsylvania by an explosion in a filter presumably caused by an electric spark from an extension cord. Another man was killed by an explosion in a tank car while assisting a workman who had been overcome by gas out of the tank car. If the specific causes of these accidents were made known to others, special provisions could be made to prevent their repetition. By placing the responsibility for accidents men are made more thoughtful about taking chances or building up unsafe conditions. No workman wants to be blamed for an accident, especially for one which injures a fellowman.

Placing Responsibility

Responsibility for accident prevention should be delegated to some individual in every plant. It should be a pleasure to the fire prevention men within the companies of the National Petroleum Association to undertake this work which can be so beneficial to your organizations, and should you, as managers of your companies, delegate accident prevention work to your fire marshals you must not get the idea that the responsibility has been passed to the fire marshal and that you, the managers, are relieved of further responsibility. You are making the fire marshal an accident prevention man to assist you in locating the hazards which may cause accidents the same as he has been assisting you in locating the hazards which may cause fires. If your fire marshal brings to your attention a situation which may cause a fire or an accident, and you as manager do nothing to change this situation and a fire or accident occurs, the responsibility will revert directly to you. You must realize that your fire prevention and accident prevention man is your assistant in protecting life and property, and you, as managers, must give him your whole-hearted encouragement and co-operation.

Suppose you buy your wife a new automobile for a Christmas present so that she may get more pleasure out of life. In order for her to do so, is it not necessary that you furnish gas, oil, and occasionally new tires, pay for paint jobs and repair bills, and probably accompany her on occasional drives? The accident prevention man is much in the same position. Management places on him the responsibility for preventing accidents, but must assist him with financial and moral support in accomplishing his work.

Accident prevention, while a welfare and humanitarian feature, has passed that point. It is a producing feature which helps to pay the dividends and is a part of good management.

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First Aid Is Bridge Between Accident And Adequate Medical Attention*

Proper methods of caring for injured told to gasoline plant workmen at Ranger meeting

By *FLOYD W. HOLDER*

FIRST aid has been defined as a bridge between the accident and medical or surgical assistance and over this bridge the injured person is to be carried from the place of injury to the place of treatment. Once the bridge is crossed and the injured person is placed in the hands of competent attention first aid is at an end. It will not be the purpose of this paper to go into detail as to rendering first aid on the different classes of accidents but to show in a more general way the value of properly administered first aid treatment.

From 75 to 80 per cent of all wounds and abrasions become infected if untreated.

The little scratch or bruise when the skin is broken may result in a severe case of blood poisoning, the same as would a big cut or severely torn tissue.

Wounds heal very fast if they are cleaned and kept clean. When we say clean we mean not only clean of dirt, but also clean of invisible germs. These germs lie on the skin and often on a tool or any object that causes the injury. When these germs are not cleaned out of the wound at once and destroyed, blood poisoning and infection may result.

Whenever any employe sustains a wound he should pursue the following course:

Report immediately to your foreman or superior, who will cause you to receive proper care for your injury.

If you sustain an injury and are at a distance from First Aid, immediately cover it with sterile gauze, clean linen and a bandage.

Do not put anything on or into the wound or bathe it with water or any solution.

The sooner you cover a wound the less danger will there be for infection.

Never use shop rags, waste or used handkerchief for cleansing or covering a wound.

For minor injuries wipe off the grime and dirt with gasoline. Then pour over and into the wound pure tincture of iodine and mercurochrome and cover with sterile gauze or linen and bandage.

After cleansing immediately cover the wound with clean sterile gauze and bandage.

Keep it covered until healed.

In severe injuries cover the wound at once with clean sterile gauze and bandage, and report to a doctor.

Never on any wound use soap, water, salve, peroxide, powder, iodoform; and never use dirty rags, waste, handkerchiefs, soiled cloths, or towels—use only clean sterile cotton, linen or gauze, and bandage.

Never attempt to prick or open any blister or wound that you may have received. Go to the company's doctor. Never remove a bandage or a dressing that a doctor has put on, no matter how dirty the outside may become. Go to the doctor to have your dressing changed.

Find where the man is hurt before trying to move him. If you believe that a bone is broken or there is a wound or that hemorrhage has started, remove the clothing over the part injured to make your examination.

Don't try to pull off clothing; cut or rip clothes if they must be taken off.

If his back is hurt, don't move him until you have help or the doctor comes.

Always place the injured man on his back, with his head lower than the rest of his body (unless he is bleeding freely about the head); open his collar and loosen his belt. Place clothing or cushions under his back to keep it warm.

Always look for bleeding, and if the blood is bright red and coming in spurts, try to stop it at once.

Don't give an injured man brandy or whisky or any stimulants while he is bleeding; keep him quiet and warm.

If any bones are broken, put on splints before moving him. If you are in doubt as to whether the bones are broken always put on splints.

If you find that he has no broken bones and is not bleeding or spitting blood, but is very pale and cold and breathes fast, keep him quiet; lay him on his back, lower his head, cover him with clothing or blankets as an aid in keeping him warm, and do not let others crowd around him, but give him plenty of air.

First Aid Pays

Experience has proven conclusively that the cost in the repair of the employe depends upon prompt and efficient first aid to put the man back on the job more quickly. Statistics show that adequate first aid saves 19.2 hours per month on every injured man. Proper material on hand to dress the hurt prevents serious complications and upon the physical efficiency of every employe depends the general efficiency of every manufacturing plant. Accidents interfere with the general working program.

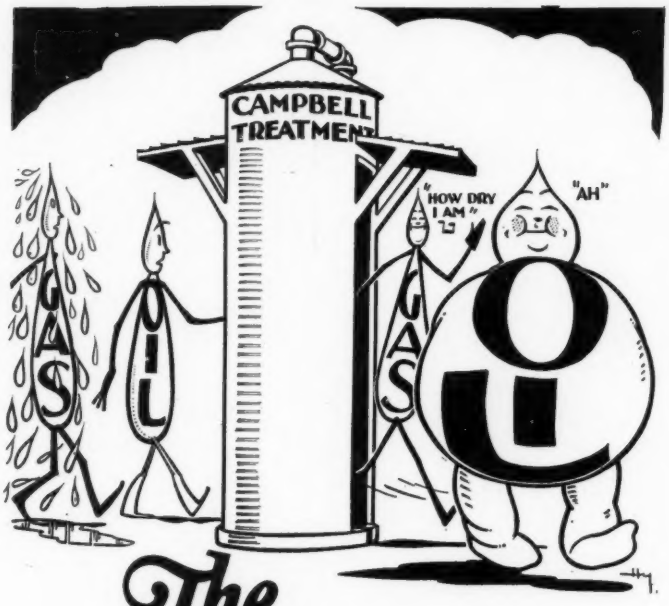
Everybody knows that accidents represent monetary loss as well as human suffering. In considering some of the monetary losses, I want to call your attention to the fact that the heaviest of them are usually overlooked. Prominent in the mind of every employer is the first or direct cost of the accident, as measured by compensation or liability claims, plus the charge for medical attention. This cost can be covered by insurance, and is paid by the insurance company. However, even this finally reverts to the employer, either in increased manual rates or a debit in the experienced rate of that particular employer, and the idea held by a great many of the employes and some employers of letting the insurance company pay, is wrong, as it is not the intention of insurance that the insurance company actually pay the losses out of their own pockets, but that they simply collect a premium from the various employers, sufficient to pay the total accidents of all of them, thereby distributing the losses of a few among many, and if the losses are excessive they reflect in increasing rates and in the long run the bill is paid by the employer. Insurance simply permits the employer to set up a definite amount of expense for accidents during the ensuing year, and safeguards against the fluctuating losses that might wipe out his entire profit for that particular year, and in case of a general average of excessive losses for that year there is an increase in premium for the next year, and he so regulates his business by charging this increase to the ultimate consumer, so it is seen that the public pays the entire cost, and in helping to reduce this cost every employe is not only helping his employer, but himself.

Other Losses

In addition to this direct and obvious cost, however, there are numerous other sources of expense involved, which are not covered by the insurance policy, but which must, in the nature of things, be borne by the employer. I shall use the word "incidental" to distinguish these secondary or non-insurable losses from the immediate, evident, insurable ones, upon which the attention of the employer is almost invariably fixed. Save for this preliminary explanation of the sense in which it is to be used, the word "incidental" would be a misnomer, because it normally means "casual" or "minor"—whereas it has been shown that the cost of accidents, other than as represented by compensation liability, and medical payments, is by far the greatest expense. An inter-

(Continued on page 104)

*Delivered at safety meeting of the Chestnut & Smith Corp., Inc., Ranger, Texas, August 18, 1927.



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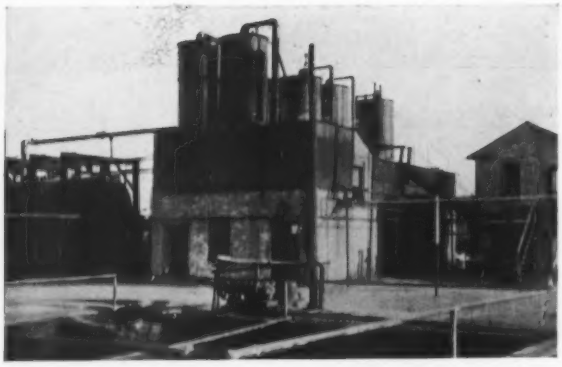

FIGURE 2—REAR VIEW OF DISTILLATION EQUIPMENT ILLUSTRATING UTILIZATION OF CONDENSER BOX AND FRACTIONATING DEVICES FOR BOTH WAREHOUSING AND PUMP HOUSE PURPOSES. THE WATER POND IN THE FOREGROUND IS ALSO A FISH HATCHERY AS DESCRIBED.

FIGURE 3—VIEW OF AGITATOR ASSEMBLY FOR CHEMICAL TREATMENT OF GASOLINE AND KEROSENE.

Rio Grande Plant at El Paso Bears Marks of War

Eight years of operation have been successful despite long distance from crude supply

By GEORGE REID
Associate Editor

ABOUT eight years ago the Rio Grande Oil Company completed construction and began operation of its 2000-barrel refinery at El Paso. At this time, May 1919, the crude oil production shipped by tank car and run through the plant was derived from the Burkburnett pool in North Central Texas. During the past eight years however, crude production has been obtained closer and closer to the company's skimming plant. Where Burburnett crude was once brought in to the refinery, the oil is now derived from the nearby newly opened territory of Artesia, New Mexico, the pools near Pecos, Texas, and the Crane-Upton area. The company now has some of its own production from these nearby producing areas which it ships in to its El Paso plant.

This refinery is possibly the only plant in the United States which bears the scars of real battle in war conditions. The plant was put in operation May 29, 1919, and on June 15 of the same year Villa and his followers staged a battle a few hundred feet across the Rio Grande river. During the melee it seems that soldiers on both battle lines took an occassional shot at the refinery tanks and smoke stacks over on the American side of the river. The eight year old smoke stack on the boiler house is still functioning, but numerous bullet holes mark the spots where soldiers aimed. A few tanks about the yards were also in need of repair after the skirmish. It is said that during the night and day of the fighting the operators on the job at the plant were far from comfortable for wild slugs of lead and steal seemed to persistantly drop in on the plant yard. Few refineries can boast of being the unwilling target of mischievous soldiery during actual warfare.

FIGURE 1—FRONT VIEW OF DISTILLATION EQUIPMENT HANDLING OVER TWO THOUSAND BARRELS OF CRUDE DAILY IN CONTINUOUS SERIES, HAVING BEEN IN ACTIVE SERVICE FOR THE PAST EIGHT YEARS

Like many refining installations constructed about 1919, this plant found difficulty in securing stills. All other material was on the ground and nearly ready for operation before stills could be obtained. After strenuous efforts to secure stills it became necessary to fabricate their own distillation units from boilers. Four of these were lengthened some, and placed in service. Later a larger shell was installed for rerunning, being 10 by 40 feet in dimensions.

Operation

At present the five 100-barrel stills and the one large shell still are operated in one continuous system. The first still, which is the larger one, is fired at a temperature sufficient to remove the lighter gasoline vapors from the crude. The vapors are conducted through two towers of the baffle type, through sterling cast iron condenser sections and to run down, without going through the receiving house. This practice eliminated the loss of light vapors occurring where light streams are conducted through look boxes for inspection.

The crude oil then enters the second still, which is small and the same size as the remaining three small stills made from boilers. Two towers are provided on both stills No. 2 and No. 3, where all of the gasoline is removed and fractionated. Streams Nos. 2 and 3 are taken through the receiving house for inspection. Stills Nos. 4 and 5 produce kerosene and heavier distillate. The refinery makes the usual variety

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of products that are concurrent with skimming plant operation.

It speaks well for the operators of the plant and for the boilers employed in making the stills, that the series has been in operation for eight years and still have the original bottoms. The plant charges about 65,000 brarels of crude monthly. Each still and boiler are equipped with Lientz furnaces, the installation of which effected a marked reduction in fuel oil consumption.

Water for plant operation purposes is secured from two wells drilled on the plant yard. These two wells produce sufficient water for plant operation with only intermittant operation. The wells are jetted with compressed air and require but about 35 pound pressure to make them flow. A Gardner 6x6-inch compressor is employed to flow the wells, and when not required for this work the same compressor, driven by a Westinghouse Electric 20-horse-power motor is used to blow the agitators. The water from the wells is discharged into a centrally located shallow pool, at 63 degrees Fahrenheit. In this pool the plant operators by way of diversion, are raising a dozen or so large gold fish and a small number of carp. Going a bit further along the lines of this fishery diversion the boys also have another dozen large, or giant, gold fish thriving nicely in six inches of water on top of a water top gasoline tank. A few small fish give evidence that the experiment was successful. The water, however, is very soft, and boilers which have been in operation during the eight years of the plant's life are almost entirely free of scale.

Sulphur

The high sulphur content of most of the crudes charged to the plant has made it necessary to discard coils in the condenser boxes and install cast iron Sterling sections. Free sulphur collects rapidly on the fittings and look boxes in the receiving house.

This excessive sulphur has presented quite a problem in the treating chemically of the gasoline and kerosene produced at the plant. At present the gasoline is treated with sodium plumbite exclusively, and though the raw material has an odor and appearance not unlike some cracked gasolines, the treated gasoline is thirty plus in color, sweet, non corrosive, and holds its color in sunlight. The kerosene treatment includes sulphuric acid. Two agitators size 350 and 600 barrels are employed in treating.

All of the pumping equipment for charging stills, transferring finished product, loading, etc., is standardized, the pumps being Worthingtons throughout the plant.

Gasoline rundown tanks are all water top. One 80,000 barrel tank is used for crude, and one 15,000 barrel tank for fuel. A large proportion of the company's products are marketed locally and within driving radius of the company's fleet of trucks. This condition makes it unnecessary to equip a large loading rack, and for loading finished products and unloading incoming crude oil at the refinery a 16-car rack is ample.

The pipe still shown in the illustrations is not at present in operation but the entire daily charge of 2000 barrels and over is handled smoothly and efficiently with no rerunning, in the four small "boiler-stills" and the one large shell still as described in the foregoing discussion. After eight years of almost continuous service the installation seems sufficiently well kept and cared for to the end that a great many more years of operation may be expected of it.

Apparatus for Vacuum Distillation of Lubricating and Heavy Oils

By MARTIN J. GAVIN[1] and ARCH L. FOSTER[2]

DURING the present study of lubricating oils in the San Francisco laboratory of the Bureau of Mines it became desirable to distill oils used in the experimental work at pressures as low as 10 mm., (mercury column) absolute. In the effort to overcome difficulties and eliminate sources of error the apparatus described below was finally developed.

The distilling flask is essentially the Hempel flask used by the Bureau of Mines for the analytical distillation of petroleum[3]. The complete apparatus is shown in Figure 1. As air leakage at connections is an ever present or potential source of difficulty and error in vacuum apparatus, the mouth of the flask is drawn down to one cm. internal diameter which materially simplifies obtaining an air-tight seal at this point. Before reducing the mouth, the spray screen is inserted and adjusted in position.

This screen is made of copper or brass gauze of 10 to 14 mesh, brazed or silver-soldered to a copper or brass tube of 4 or 5 mm. internal diameter. It is essential that the mesh of this screen be not too close or a column of oil will build up above it and eventually spatter over into the delivery tube and make an accurate distillation impossible. It is also important that the gauze have sufficient strength and rigidity to support the screen against the strains put upon it in charging, cleaning, etc. The supporting tube permits the introduction of small bits of broken Tonteller (boiling stone) into the charge of oil. After the screen is inserted into the neck of the flask it is conveniently held in place by heating small points on the neck wall with a blast flame and forcing the glass inward with a sharp point. Three or four points so placed at intervals just above and below the upper and lower screens respectively will suffice to retain the screen in position.

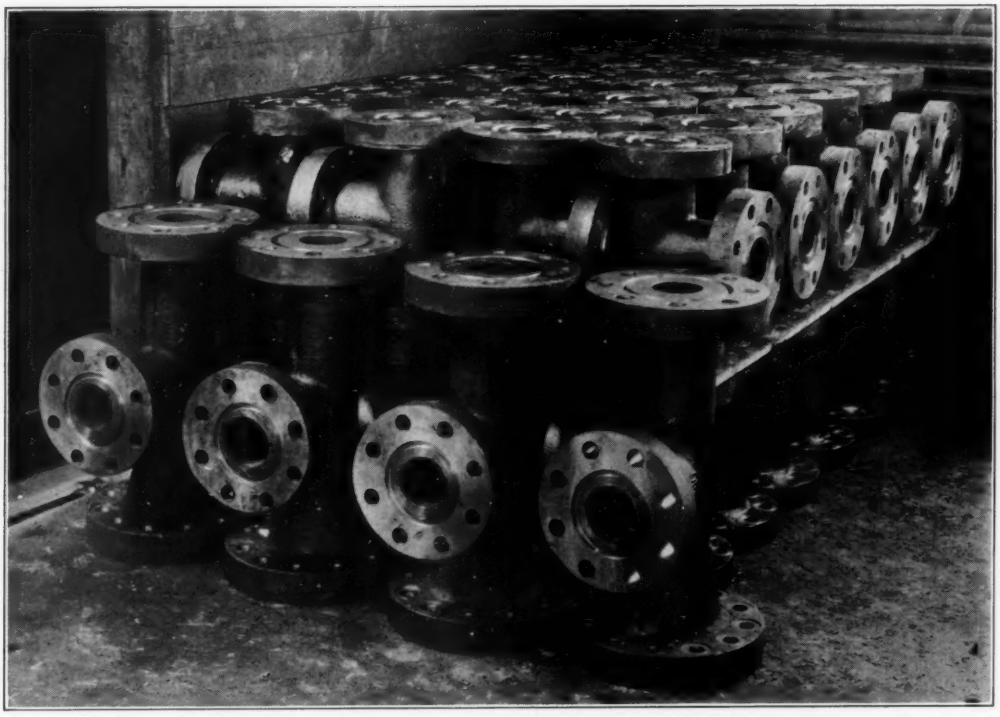
Even with fresh Tonteller placed in the flask before each distillation there was much trouble from bumping when heavy oils were distilled at 10 mm. Observation showed that the explosive vaporization in the overheated bottom layer of oil was coincident with the fall of the condensed droplet which collected at the discharge end of the side neck and plugged the vapor line until the drop fell of its own weight. This permits a slight building up of pressure in the flask and when the drop falls and opens the line, the sudden release of this increment of pressure permits the vaporization to occur at such a rate as to approach the proportions of an explosion, throwing liquid oil up through the screen and over into the delivery tube, vitiating the results of the determination.

To eliminate this trouble two 1/16-inch holes were blown in the end of the delivery tube, ¼-inch above the lowest extremity, as shown in Figure 1(H); this permits drops to form and fall into the condenser and at the same time prevents the slight fluctuation in pressure within the flask which causes the bumping. Under this arrangement, the distillation proceeds as smoothly as at atmospheric pressure.

Condenser and receiver are those described in Bureau of Mines Bulletin No. 207, the receiver holding nine graduated test tubes for collecting the various fractions.

To increase condenser efficiency a small gauze screen is inserted, convex side up, in the condenser just below the delivery tube; this distributes the hot condensate evenly over the condenser wall, allows it to cool to a lower temperature before it reaches the receiver and decreases or eliminates the volume correction to be applied to

[1]Refinery engineer, Bureau of Mines, Department of Commerce.
[2]Associate petroleum chemist, Bureau of Mines.
[3]E. W. Dean and others: Analytical Distillation of Petroleum, Bureau of Mines Bull. 207, pp. 10-23.



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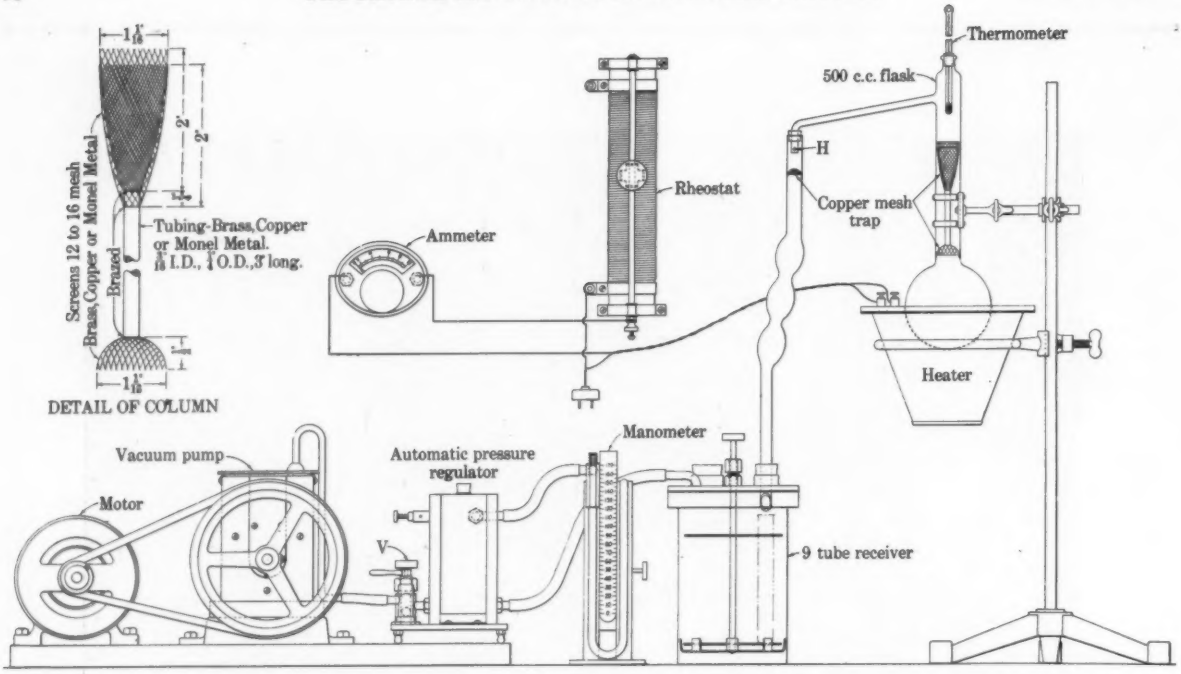

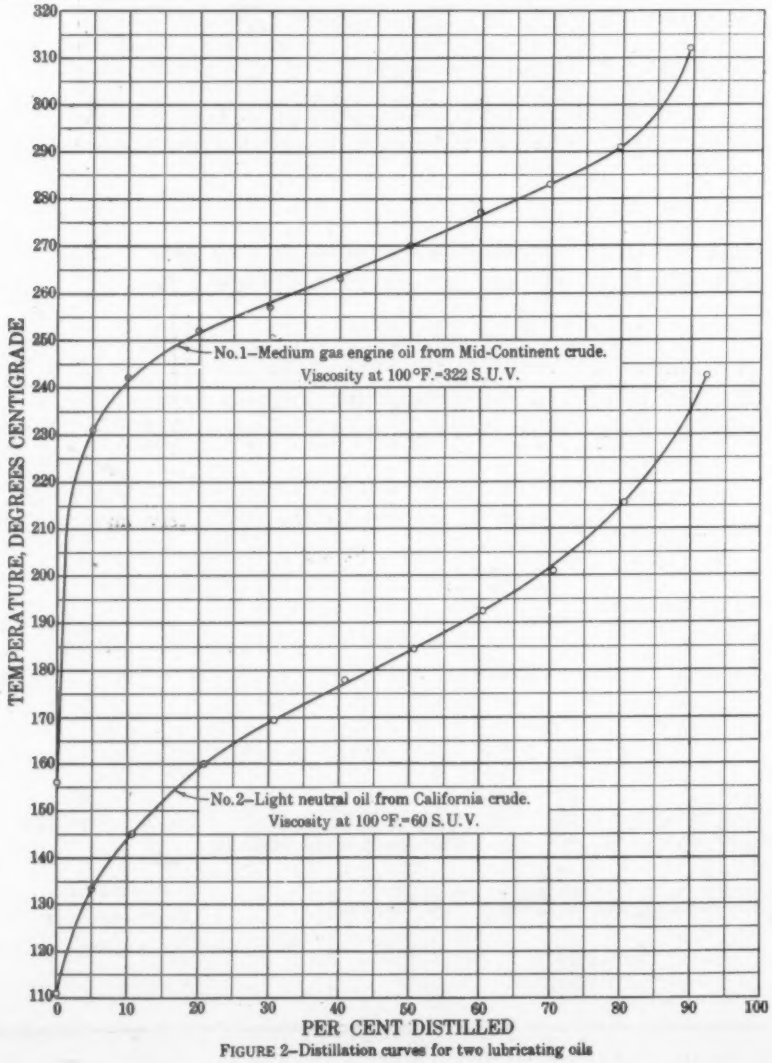
TEMPERATURE, DEGREES CENTIGRADE
PER CENT DISTILLED
No. 1–Medium gas engine oil from Mid-Continent crude. Viscosity at 100°F.=322 S.U.V.
No. 2–Light neutral oil from California crude. Viscosity at 100°F.=60 S.U.V.

FIGURE 2–Distillation curves for two lubricating oils

the distillate fractions for contraction on cooling in the receiver tube.

The pump used by the writers is a regular Cenco Hy-Vac. Pumps of this general type have ample capacity and if the system is carefully sealed, distillations may be carried out with ease at 1 mm. or lower.

The distillation procedure is as follows: Small pieces of Tonteller are dropped into the flask through the open tube of the screen, the desired quantity of oil is poured into the flask, through a long funnel; a distillation thermometer with tight fitting cork is adjusted in the mouth of the flask and the delivery tube connected to the condenser by a snug cork. If necessary the joints are luted with litharge-glycerin paste and the pump started. When the pressure has been reduced to the desired degree as indicated by the closed manometer the valve, v, is partly closed and by trial adjusted so that the pressure is constant; the heating is started, the oil brought to distilling temperature very gradually with steadily increasing heat, and the slide wire rheostat so regulated that the oil distills at a rate of 3 to 5 cc. per minute. Some manipulation of the control valve, v, is necessary to adjust the pressure after the system is in full operation but once adjusted it requires remarkably little attention to regulate within very narrow limits. Ordinarily the automatic pressure regulator is not used, as manual control of pressure is quite satisfactory. If the regulator is not used it is advisable to have a reservoir of at least one liter capacity in the suction line between valve "v" and receiver to smooth out minor pressure fluctuations.

By this apparatus and method it is a comparatively simple matter to obtain clean-cut distillations, the data

The FOUNDATION

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Table 1—Showing results of vacuum distillations of lubricating oils from various crudes.

MEDIUM INTERNAL COMBUSTION ENGINE OILS

From

MID-CONTINENT CRUDE — **GULF COASTAL CRUDE**

Cut No.	(1) New Vol. c.c.	Dist. per cent	Temp. °C.	(2) Used Vol. c.c.	Dist. per cent	Temp. °C.	(3) New Vol. c.c.	Dist. per cent	Temp. °C.	(4) Used Vol. c.c.	Dist. per cent	Temp. °C.
over	0.0	0.0	156.0	0.0	0.0	150.5	0.0	0.0	142.0	0.0	0.0	135.0
—	3.0	1.2	205.0	3.0	1.2	208.5	3.0	1.2	179.0	3.0	1.2	176.0
—	6.0	2.4	220.5	6.0	2.4	224.5	6.0	2.4	186.0	6.0	2.4	188.0
—	9.0	3.6	227.0	9.0	3.6	231.0	9.0	3.6	190.0	9.0	3.6	200.5
1	25.0	10.0	242.0	26.7	10.7	243.8	25.4	10.1	201.5	28.0	11.2	214.0
3	75.6	30.0+	257.0	76.6	30.6	254.0	51.6	20.6	214.5	53.6	21.4	220.5
2	50.0	20.0	252.0	51.6	20.7	268.5	101.2	40.5	228.0	104.4	41.7	242.5
4	100.0	40.0	263.0	100.9	40.70	268.5	101.2	40.5	228.0	104.4	41.7	242.5
5	125.0	50.0	270.0	125.6	50.3	277.2	126.8	50.7	235.0	129.4	51.8	251.0
6	149.8	60.0	277.0	155.1	62.1	286.0	152.2	60.9	245.0	154.8	61.9	257.5
7	174.4	69.7	283.0	179.5	71.8	293.5	177.4	71.1	252.0	182.2	72.9	265.5
8	199.2	79.6	291.0	202.0	80.9	305.5	204.4	81.8	265.0	207.2	83.0	276.5
9	223.4	89.4	312.0	222.6	89.0	320.5	227.6	91.1	277.0	226.2	90.5	284.0

CALIFORNIA CRUDE — **PENNSYLVANIA CRUDE**

	(5) New			(6) Used			(7) New			(8) Used		
over	0.0	0.0	162.0	0.0	0.0	152.0	0.0	0.0	210.0	0.0	0.0	160.0
—	3.0	1.2	173.0	3.0	1.2	175.0	3.0	1.2	216.0	3.0	1.2	201.0
—	6.0	2.4	177.0	6.0	2.4	182.0	6.0	2.4	221.0	6.0	2.4	225.0
—	9.0	3.6	180.5	9.0	3.6	185.0	9.0	3.6	224.0	9.0	3.6	228.0
1	25.4	10.1	193.0	25.0	10.0	198.5	25.0	10.0	231.0	25.2	10.1	235.5
2	50.8	20.3	210.0	50.0	20.0	214.0	50.0	20.0	241.0	50.2	20.1	248.0
3	76.0	30.4	220.5	75.0	30.0	226.0	75.0	30.0	248.0	75.0	30.0	254.0
4	101.0	40.4	229.5	105.0	42.0	236.0	99.8	39.9	254.0	100.0	40.0	261.0
5	126.2	50.5	241.0	131.4	52.5	248.0	125.2	40.1	262.0	125.0	50.0	268.0
6	151.4	60.6	252.0	152.0	60.8	254.0	151.6	60.7	271.0	149.4	59.7	276.0
7	178.4	71.4	266.5	174.0	69.6	268.5	176.2	70.5	278.0	174.4	69.7	285.5
8	207.4	83.0	280.5	196.4	78.6	276.5	201.8	80.7	292.0	200.2	80.1	296.5
9	227.8	91.0	295.0	222.4	89.0	296.0	225.8	90.3	311.0	225.0	90.0	314.5

on which are accurate, comparable, and reproducible. Vapor temperatures, especially, are more reliable and reproducible than with any other method so far attempted.

Examples of data obtained, using this apparatus, are shown in Table 1. Nos. 1, 3, 5 and 7 are distillations on medium internal combustion engine oils made from the various crudes as noted, while Nos. 2, 4, 6 and 8 show results on these oils after being used in experimental engine runs in the San Francisco laboratory.

Table 2 also gives distillation results on two oils varying widely in volatility and viscosity, and curves from this data are shown in Figure 2.

Table 2—Showing differences in volatility and viscosity between two new oils

Cut No.	Temp. °C	Vol. Distilled c.c.	Vol. Distilled per cent	Temp. °C	Vol. Distilled c.c.	Vol. Distilled per cent
over	156.0	0.0	0.00	111.0	0.0	0.0
½	231.0	12.5	5.00	133.5	12.5	5.0
1	242.0	25.0	10.00	145.0	26.8	10.72
2	252.0	50.0	20.00	160.0	52.2	20.88
3	257.0	75.6	30.02	169.5	77.2	30.88
4	263.0	100.0	40.00	178.0	102.0	40.80
5	270.0	125.0	50.00	184.5	126.8	50.72
6	277.0	149.8	59.98	192.5	151.4	60.56
7	283.0	174.4	69.75	201.0	176.4	70.56
8	291.0	199.2	79.70	215.5	201.4	80.56
9	312.0	223.4	89.40	242.0	230.4	92.16

Reports of Investigations, Bureau of Mines, Department of Commerce.

Imperial Refining Company, Ltd., operating a refinery at Sarnia, Ontario, is equipping this plant with a Newton type vapor recovery system, which will produce gasoline by the absorption method, derived from the vapors from run down and storage tanks, and the receiving house inspection boxes.

D. E. Buchanan, president and general manager of manufacture and sales of the Chestnut & Smith Corporation, Tulsa, returned late in August from a three months tour of Europe. Mr. Buchanan visited England, Holland, Germany and France in the interests of his company and looking into the export sale of natural gasoline.

Nacogdoches Plant Sold

Nacogdoches, Texas.—The control of the Yuba Oil Refining Company, which is operating a 200 barrel daily capacity lube plant in the Nacogdoches oil field, has been purchased by James B. Evans and associates of Beaumont from Mrs. Phoebe M. Rideout of San Francisco, California. The new owners also acquired a number of shallow oil wells in the transaction, and will continue to operate the plant.

Erect Six Eighties For Pennzoil Storage

Oil City, Pa.—The South Penn Oil Company has purchased a 40-acre farm on the hill adjoining the property of The Pennzoil Company. They have contracted for the erection of six 80,000 barrel steel storage tanks with gas tight steel roofs and expect on the completion of these tanks to transfer their surplus crude oil which is now stored in various rented tanks.

Their purpose in erecting these tanks is to carry adjacent to the Pennzoil refinery, such stocks of crude as will prevent any possibility of interruption at the refinery in case of any break-down or congestion in the various pipe lines carrying the oil to Rouseville.

Shreveport.—Construction work was begun early in August on the Magnolia Petroleum Company's absorption gasoline plant which is being installed to increase production and capacity of its old compression gasoline plant between Spring Hill, and Sarepta, La. Gas from the Cotton Valley and Carterville fields will be treated.

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Receivers Will Operate American Refinery

Wichita Falls, Texas.—The American Refining Company of Wichita Falls, Texas, was placed in receivership through the action of the federal court on August 22. The company joined with creditors in asking for the receivership.

The receivers appointed by the court are John W. Hooser, independent oil operator of Dallas; E. H. Eddleman, vice-president of the Continental Oil Company of Texas, with headquarters in Wichita Falls, and J. C. Mytinger, oil and real estate operator, Wichita Falls. The receivers plan to continue the operation of the properties.

Properties of the company include the 7000 barrel skimming plant with four Dubbs and two Cross cracking units, located on valuable property just north of the city. Production in north Texas and the Panhandle amounts to about 1500 barrels daily. The company also has a large number of bulk distributing plants and service stations.

Arkansas City, Kansas.—The Kanotex Refining Company, operating an 8500 barrel capacity skimming plant, is installing four new fractionating towers of latest design, which will be placed in operation at an early date.

Reconditioning Refinery

San Angelo, Texas.—The 2000 barrel refinery of the San Angelo Refining Company, which was seriously damaged by fire some weeks ago, is running at 50 per cent capacity while the work of reconditioning and reconstructing is progressing nicely. This work is to be completed by the latter part of September. The new installation is of the latest type of equipment, consisting of pipe still and bubble type fractionators accomplishing complete separation of all products at one heating operation.

Dismantle Refinery

Wichita Falls, Texas.—The old Beaver Refining Company plant west of Wichita Falls is now being dismantled. The plant was constructed eight years ago during the Burburnett boom days, and was operated but a short time. After being shut down for a while the Constantin interests leased and operated it under the name of the Petroleum Corporation. At the expiration of the lease the plant was again shut down and has not been in operation for a year or more.

Double Destrahan Plant

New Orleans, La.—It is currently reported that The Pan American Petroleum and Transport Company contemplates the enlargement of its Destrahan, Louisiana, refinery, to the extent of doubling its present capacity of 25,000 barrels daily. The plant is running on Venezuela and Texas crudes. Enlargement of the plant is necessitated by the expansion of the company's marketing division in the Mississippi valley.

Los Angeles, Cal.—Petroleum Securities Company has increased the capacity of its Seal Beach gasoline absorption plant. One additional seven-foot Campbell Oil Froth absorber has been installed which has a maximum daily capacity of 8,000,000 cubic feet of gas. The Seal Beach plant is now treating 40,000,000 cubic feet of gas daily.

Brown Company Adds Kansas City Office

Kansas City.—The Brown Instrument Company, with headquarters in Philadelphia, has announced the opening of a branch office in Kansas City, at 509 Mutual Building.

This office is the result of a growing demand for Brown pyrometers, gauges and flow meters in Kansas and surrounding states.

F. M. Poole will be district manager, in charge of the new office.

"Two-thirds less cost and it does the same work?"

"Do you mean to tell me, Frank, that those Sarco Steam Traps you installed some time ago cost only *one-third* as much as our big traps and that they are doing the same work?" queried Simmons, the V.P.

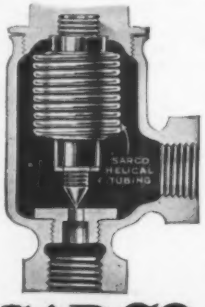
"Yes," replied the engineer, "and in addition we saved considerable money by screwing the Sarco Traps right into the pipe-line instead of having to build an expensive platform as we did for the old traps."

"Have any trouble adjusting them?"

"Didn't have to adjust 'em . . . they're self-adjusting for all pressures from 0 to 100 pounds."

"Have they given any trouble or shown any wear?"

"Wear?" blurted Frank. "There's nothing to wear—no levers, gauges, stuffing boxes, float or bucket—only one moving part. And as for trouble, why I'd almost forgotten about them—haven't had to touch those traps since we put them in."



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Results of Tests on Splitting "Dumps" In Treating Lubricating Oils

(Continued from page 68)

of water by the addition of a small portion of acid before beginning the principal operation of refining. Use is often made of the acid from a previous operation for this purpose, it being still strong enough to effect this preliminary separation of the water."

The Test

With the foregoing general facts concerning the influencing factors involved in the sulphuric acid treatment of oil (particularly, lubricating oil) clearly in mind, the reader probably will be able to grasp more thoroughly the results of laboratory tests made in applying acid to a lubricating oil in various dosages or "dumps" or, in other words, the so-called "fractional addition of the acid."

The oil upon which these laboratory tests were made was a long residuum (residual oil) of 425 degrees F. flash test resulting from the reduction (by a fire and steam distillation) of Salt Creek, Wyoming, crude oil. This residuum had a pour test of about 110 degrees F., and, although the oil was high in wax content, the crude itself is of mixed base characteristics and hence the residuum contained large quantities of asphaltic matter that had to be removed before lubricating oils of a marketable grade could be made therefrom.

A total of 45 lbs./barrel of 66 degree Baume sulphuric acid was applied to the oil in 10 different treatments and all results carefully recorded.

The acid was applied to the oil in the following different dosages:

Oil. No.	First Dump lbs./bbl.	Second Dump lbs./bbl.	Third Dump lbs./bbl.
SC 8	45	....	....
SC 9	22.5	22.5	....
SC 10	30	15	....
SC 11	15	30	....
SC 12	15	15	15
SC 13	17	17	11
SC 14	30	10	5
SC 15	20	15	10
SC 16	5	20	20
SC 17	8	27	10

A total of 4000 cubic centimeters of oil was taken for each treatment.

The temperature at which the oil was both treated and settled was 140 degrees F.

The oil was air agitated for from 20 to 45 minutes (latter in one case only), or for the shortest possible time necessary in order to have a "clean" separation of the resultant sludge. The average time of agitation was between 25 and 30 minutes.

Table I shows the detailed results obtained from this series of treating tests. It is to be noted that the percentage loss (and hence indicative of the amount of asphaltic substances removed from the oil) varies from 25.28 per cent to 30.83 per cent. The percentage loss was least on SC17 (the 8-27-10 treat), where it was 25.28 per cent and on SC8 (the 45 lb. treat), 26.72 per cent; while the loss was greatest on SC12 (the 15-15-15 treat), where it was 30.83 per cent and on SC9 (the 22.5-22.5 treat), 30.68 per cent.

All oils were contact filtered to a 5.5 N. P. A. color with finely divided decolorizing materials.

Oil SC11 (the 15-30 treat) required the smallest quantity (1⅜ lbs./gallon) of "100-up" mesh fullers earth to obtain a 5.5 N. P. A. color.

Oil SC13 (the 17-17-11 treat) required the smallest quantity (3¼ lbs./gallon) of a 200-mesh, untreated Utah clay of the bentonite type to obtain a 5.5 N. P. A. color.

Oil SC9 (the 22.5-22.5 treat) required the smallest quantity (1⅜ lbs./gallon) of a 200-mesh treated clay (a Utah clay of the bentonite type that had been treated with about 5 per cent by weight of acid and the acid allowed to remain in the clay) to obtain a 5.5 N. P. A. color.

In addition to showing the way in which the acid would be fractionally added to this particular oil in order to remove the largest amount of asphaltic matter, these laboratory tests (with the subsequent filtration tests) showed also that the decolorizing effect of a given filtering material (that is, when such oil is contact filtered) is dependent also on the amount of free acid remaining in the oil as well as on the efficiency of the particular acid treatment.

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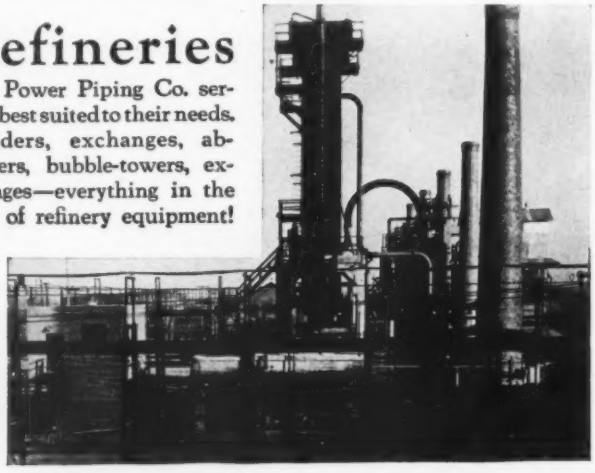

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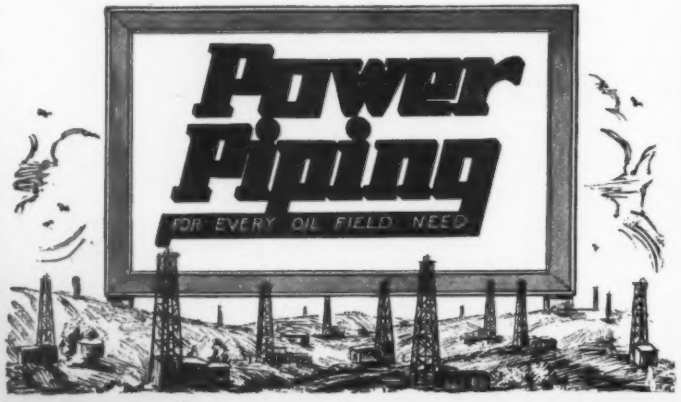

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Vapor Phase Refining increases the yield of refined cracked gasoline by eliminating acid treating losses. Where end-point gasoline can be produced directly from the cracking unit it also eliminates rerunning losses.

These advantages are so clear in commercial operation that in every refinery where the original installation was planned for a part only of the cracked gasoline, or where more cracking units have been added, further Vapor Phase Refining capacity has been installed or planned.

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First Aid Is Bridge Between Accident and Adequate Medical Attention

(Continued from page 90)

esting and perhaps disturbing feature to employers lies in the fact that this so-called "incidental" expense is one that they, themselves, must pay out of the profits or assets, of their business—and therein lies the particular appeal of the line of thought herein presented.

Since it is not only possible, but also quite common, for an employer to buy insurance in a form that protects him against the violent fluctuations in individual plant experience, the statements relating to employer-cost in this paper do not contemplate compensation or liability insurance premiums. This phase of relatively heavy accidents is buried under generalities and incidental expense of operation and consequently neglected.

The general subject of accident prevention is gradually consuming a greater prominence in industrial, social and public life. Employers are becoming more and more receptive to the idea that accident prevention has a tremendous moral and humane significance, yet they are likely to remain more or less inactive unless they are presented with an incentive in addition to that which is based upon humanitarian principles. This is not an arraignment of employers, nor an accusation of social turpitude on their part, but merely a recognition of the well-known fact that acts that are founded on purely humanitarian motives are usually impulsive, and are seldom as self-sustaining as those that are based on physical or financial self-preservation, because any activity of this latter kind is kept alive through constant and direct reminder by the obvious penalties attendant upon lapse.

The point I am trying to make is that no gauge has yet been given, whereby the employer can measure under existing methods of cost accounting and by means of factors already known to him, the cost of accidents to his own industry. Except in rare cases, moreover, it is unfortunately true that accident data are not gathered nor tabulated in ways that permit accurate estimation of expense, other than of that which is represented by lost time of the injured person, and by the compensation, liability and medical aid cost. For example, an analysis of 5000 specific accident reports, drawn at random from the files of one of the large insurance companies, shows that the incidental accident cost, paid by the employer directly, is four times the total cost represented by the compensation, liability claims and medical treatment.

In brief, the loss consists of loss of time of injured employe, loss of time to other employes who stop work for various reasons on account of the accident, loss of time by the foreman, supervisor or clerical men in assisting the injured employe, investigating the cause of the accident, arranging for the injured employe's production to be continued by some other employe, training or breaking in a new employe to replace the injured, preparing state accident reports, or attending hearings before the Industrial Commission. These are only a few of the items figured in the cost, and the occurrence of an accident often starts a general chain of circumstances involving not only lost time, interference with production, spoilage, and weakened morale, but many other conditions as well, that seem to run in an endless and vicious cycle, as everyone will agree who cares to think about it carefully.

On the surface the entire cost is paid by the employer, however, we are all well aware that the financial success or failure of any concern vitally affects every employe of that concern, as this condition is always reflected sooner or later in either increasing or decreasing wages and every employe knows that his chances of promotion and wage increase depends entirely upon the financial success of his employer. It is, therefore, the duty of every employe not only to his employer, but to himself, to take every precaution to reduce the appalling number of accidents to a minimum.

Los Angeles, Cal.—The Newton Process Manufacturing Company, Fullerton, announces the appointment of J. E. Kobernick as general manager of that company. Mr. Kobernick succeeds W. J. Carmichael, former general manager, who resigned in July to give all his time to another business and to look after his private interests in Orange County, California.

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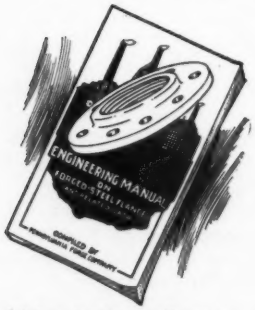

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The strength of the line is only the strength of the Flanges

PENNSYLVANIA FORGE CO.

Mention Where You Saw the Advertisement

New Developments in Petroleum Manufacture

(Continued from page 84)

against it. Its merit, however, is undoubted and wider use is to be expected.

Other Improvements

The subject of centrifugal dewaxing is too well known to all of you to require more than reference and the statement that its application has been broadened and improved.

Other improvements now available to the refiner are vapor phase treatment of gasoline with fuller's earth, various methods of sweetening, of sulphuric acid regeneration and of recovery of gasoline from refinery gases.

From the mechanical viewpoint, we note many worth while advances among which are use of the Diesel motor; improved steam and electrically operated pumps, including those for hot oil; larger forged reaction chambers for cracking; alloys for special purposes; measuring instruments; automatic controllers for temperature, pressure, liquid level, etc.; sampling devices; paints and other protective coatings; refractories and heat insulation.

Perhaps the most serious problem confronting refiners today is that of corrosion. Even those of you who have suffered but little in the past will become vitally interested as crude becomes more corrosive through increase of chlorides or sulphur content. Cracking and pipe still operations make the matter still more important because the indirect cost of interrupted use of the apparatus is quite as serious as the cost of repairs and replacements. The remedies for corrosion troubles can come only from research—if that overworked word is permissible. Furthermore, the investigational search for causes, effects and preventive measures must be co-operative between all branches of our industry. It is my firm belief that the crying need in corrosion study is a leader, a man with necessary technical knowledge, with enthusiasm, vision and balance and a man who can command or win the whole hearted respect and confidence of the petroleum industry. Committees can help the work in advisory and other capacities, but the work needs an individual director with complete authority and adequate financial backing.

As we look backward in survey of manufacturing progress, we see many mistakes, many improvements overlooked. Thus has it always been with human effort. However, the petroleum refiner is no more a laggard in development than he was a slacker in the war. I resent, hotly and justly, remarks to the contrary that appear from time to time in the press. We should all be proud of our affiliation with an industry which, in the face of criticism from many quarters, forges steadily ahead, linking theory with practice, science with art, developing not only method, apparatus and product, but above all, developing men, and men who are deserving of high honor in the annals of physics and chemistry, of engineering and commerce.

THE WATEROUS ROTARY PUMP

The Waterous Pump Is Ideal for Direct Motor Drive

Although the Waterous is well adapted for direct drive, it is also available with belt drive, gear reduction, steam engine, etc. Each pump is correctly proportioned to its particular job.

An examination of the specifications of this pump will reveal many high-grade features such as patented rotors, anti-friction outboard bearings, extra deep and accessible stuffing boxes, extra heavy shafts, bearings and gears, etc.

May we figure on your pumping requirements? Complete information upon request.

Pressures to 300 lbs. Capacities to 2000 G. P. M.

Applications for representation in open territory will be considered from responsible parties.

Waterous Dependable

WATEROUS COMPANY

SAINT PAUL, MINNESOTA

New York City Office: 342 Madison Ave.

Also Manufacturers of the Waterous Fire Hydrant

Junk Vinita Plant

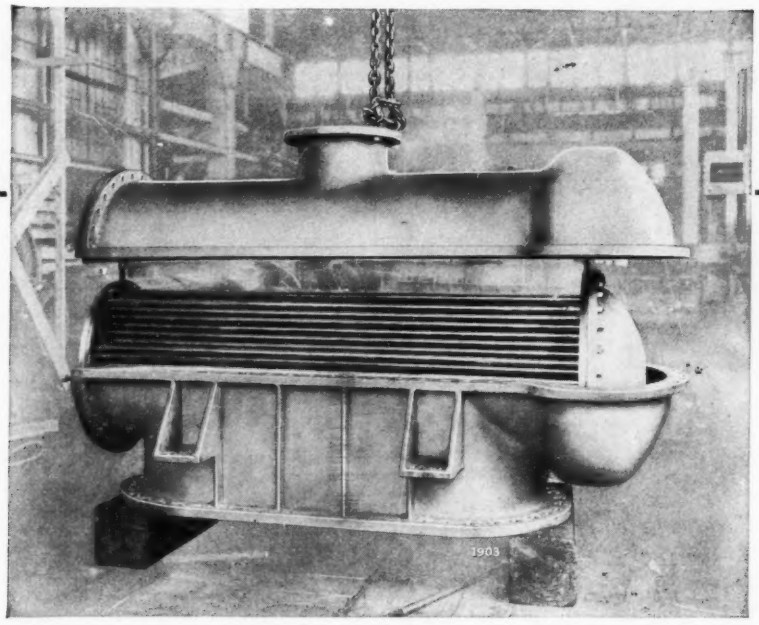
Tulsa.—The Vinita, Oklahoma, refinery of the Sinclair Refining Company, which has been shut down for several years, has been sold to the United Iron Works of Joplin, Mo., and is being dismantled. The equipment is being scrapped or shipped for service elsewhere.

Complete Cracking Unit

Chatham, Ontario.—On the plant site of the Maple Leaf Refining Company, Coutts, Alberta, the Beaver Refining Company has about completed the construction of its cracking unit. The Beaver Company will purchase gas oil from the Maple Leaf concern for charging to its cracking unit, which is of the Leamon vapor phase type.

The Maple Leaf Refining Company has been in operation at Coutts for some time, running crude oil from the Sunburst field of Montana.

Havre, Mont.—The Milk River refinery at this town is nearing completion and the first unit is scheduled to be in operation within 60 days. Plant will have a daily charging capacity of 5000 barrels.



Vacuum Distillation Extends the Range of Oils Adaptable for Lubricating Stock

THE temperature of distillation is reduced with the pressure on the oil so that heavy oils may be purified by distillation without altering the composition by overheating. Wheeler apparatus for high vacuum distillation consists of steam jet vacuum pumps and thermo-compressors for any commercial vacuum (29½ in. or over), vapor condensers, and vapor heat exchangers.

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A Consolidation of the Power Specialty Company and Wheeler Condenser & Engineering Co.

Main Office, 165 Broadway, New York

Works: Carteret, N. J., Danville and Newburgh, N. Y.
St. Catherine, Ont., Canada, Egham, Surrey, England.

Bulletins describing any of our products will be sent upon request.

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HEAT EXCHANGERS
(Liquid to Liquid)
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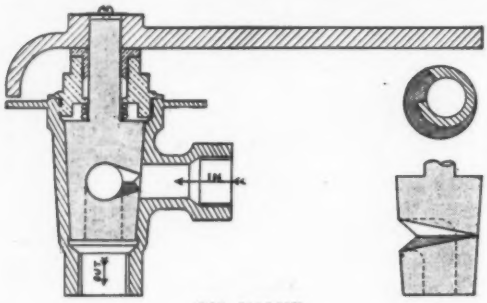
SUPERHEATERS
ECONOMIZERS
CHEMICAL AND GAS HEATERS
WATER COOLED FURNACES
PULVERIZED COAL EQUIPMENT
BRASS AND COPPER TUBE AND PIPE

118

NEW EQUIPMENT, CATALOGS, BULLETINS, BOOKS



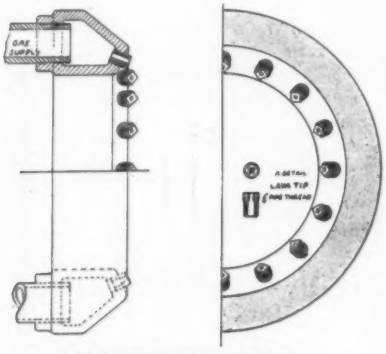
OIL VALVE

New Combustion Items

ALCORN COMBUSTION CO.

Alcorn Combustion Company, Bellevue Court Building, 1418 Walnut Street, Philadelphia, announces the introduction of several items adapted to use in refineries.

A close regulating oil valve, made of bronze, was designed for close control of fuel. The groove in the plug of this valve is so designed as to give as fine adjustment as is necessary over any particular range.



MULTIJET GAS BURNER

The flow in this valve is such that the valve cleans itself, making it especially adapted for fuels containing sediment. A movement of the handle through 180 degrees corresponds to a movement of about 20 degrees for the ordinary cock.

The multijet gas burner uses tips of various alloys or heat and acid resisting materials such as "lava." It is claimed that this feature overcomes the chemical action of certain fuels, and that the orifices are not changed by either oxidation or the action of sulphur.

The preheat oil burner is so designed that if desired gas can be fired in moderate quantities, and the burner can be used for both gas and oil within certain ranges. In designing the burner care was taken to see that the temperature of the fuel oil was brought to a point where the viscosity was lowered as far as possible.

More details on all this equipment will be supplied by the company, on request.

New Furnace Tile

George P. Reintjes Company, 2517-19 Jefferson Street, Kansas City, Missouri, is announcing the Reintjes Flexible Corner Bonding Tile, which is said to effect excellent bonding in both side and end walls of furnaces.

The tile gives ample clearance for expansion at the corners. It can also be placed in the side wall at intervals to take care of expansion needs. The expansion joint is provided either by parting of the tile, or clipping with a trowel the end of one tile.

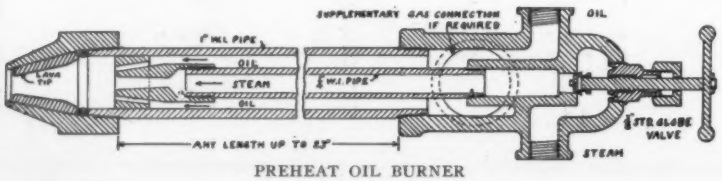
The tile is the thickness of one course of brick and it serves as a starting brick for each course. The joints break at each succeeding course and are said to form a perfect corner of the inner nine-inch refractory lining. The tile in each course overlaps the next lower course. The tile is developed for use when the brick are set in the solid header or quarter bond patterns.

More information will be provided by the company, on request.

Chaplin-Fulton Company to Enlarge Plant

Pittsburgh.—A contract has been let and plans announced by Chaplin-Fulton Manufacturing Company, of this city, for a new four story plant and office building, at 38-40 Penn Avenue. Contract calls for the plant to be completed by January 1. This property adjoins the present Chaplin-Fulton factory.

This expansion program will give the company 100 per cent increase in capacity.



PREHEAT OIL BURNER

Ross Heater Company Opens Dallas Office

Dallas.—Ross Heater and Manufacturing Company, with headquarters in Buffalo, New York, have opened an office in Dallas, at 309 American Exchange National Bank Building, under the supervision of W. K. Kirby.

The Dallas office will handle the states of Texas, Oklahoma, Louisiana and Arkansas.

The Ross Heater and Manufacturing Company manufactures equipment for refineries, casing head gasoline plants and power plants. The line comprises heat exchangers, coolers, water, oil and vapor condensers, feed water heaters, partial condensers, reboilers, expansion joints, duplex strainers, jet steam air ejectors for high vacuum distillation and other power plant and refinery equipment.

Mr. Kirby has had about 20 years experience in all branches of the oil industry and has been connected with a num- of the big oil companies.

Centrifugal Blowers and Compressors made by the Elliott Company, Jeannette, Pennsylvania, are described in a bulletin just released by that company.

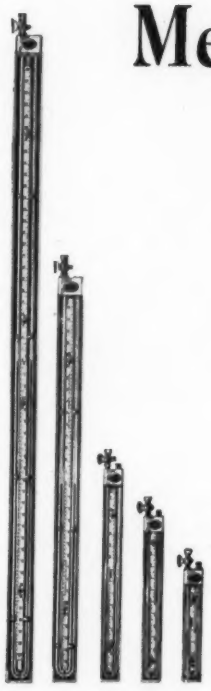
These machines have widespread application in the refining industry. Copies of the bulletin will be mailed upon request for Bulletin-P.

The Worthington Double-Acting, Two-Cycle Diesel Engine, made by the Worthington Pump & Machinery Corporation, 115 Broadway, New York City, is described and fully illustrated in Bulletin No. S-173, published late in July, this year. Copies of the catalog will be mailed on request to the company.

H. S. Shuey, of the Alloys Company, a subsidiary of the Merrill Company, has recently returned to Los Angeles, after an extensive trip throughout the Northwest and Pacific Mountain States. He reports that the following representatives have been appointed to handle the distribution of Merco Pipe Joint Compound:

The Republic Supply Company, Denver, Colorado; the Beebe Company, Portland, Oregon; Gordon & Belyea, Ltd., Vancouver, B. C.; Robert M. Hartwell Company, Inc., Los Angeles, California; R. J. Glendenning & Company, Salt Lake City, Utah; Industrial Belting & Supply Company, San Francisco, California; V. S. Jenkins Company, Seattle, Washington; Atlas Packing & Rubber Company, Seattle, Washington; B. V. Emery & Company, Inc., Tulsa, Oklahoma; Greene Brothers, Wichita Falls, Texas.

M. H. Newell, manager of the Alloys Company, is leaving Los Angeles in September, for an extensive eastern trip for the purpose of appointing agents throughout the East.



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for accurately measuring pressures, vacuum
or differential pressures.
Fine for checking accuracy of Orifice Meters
and low pressure recording gauges

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All Sizes—High Line or Low Line Pressure

MANOMETERS

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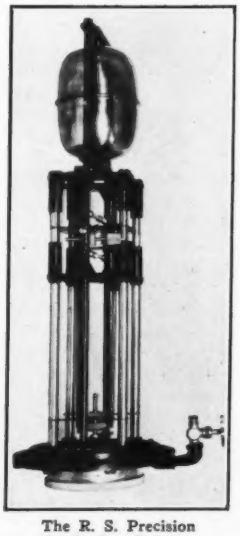

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S. G. Gas Balance

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Complete protection against any possible infringement litigation.

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The most substantial and accurate machine manufactured.

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The REAL REFINERY SERVICE SUPPLY Co.

TULSA, OKLA. DALLAS, TEXAS

One of our Spray Nozzle Cooling Systems in operation at the plant of a Louisiana oil refinery. This spray pond is equipped with our Impact Type spray nozzles.

Spray Ponds for Refineries

ONLY a nozzle that will not clog will do for refining plant spray pond installations. The need for a plentiful supply of cooling water at all times is too great to take chances with a nozzle that may clog after a few months. In our Spirodome Nozzle the orifice is larger than that of the ordinary spray nozzle, thus eliminating all danger of clogging and the need of frequent cleaning.

Our new Bulletin 262-R describes this nozzle, also our Automatic Drain and Flush-out Valve (Is your pond equipped with one?) and our other spray pond equipment.

Write for Literature

Our company is composed of engineers whose long experience with cooling water problems entitles them to your confidence. We have designed and built cooling towers and spray nozzle cooling systems for firms like Marland Refining Company, Union Oil Company, Roxana Petroleum Company and others equally well known.

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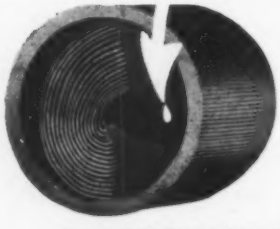
Representatives in Other Principal Cities

The Spiral Motion Is the Trick



That's why Hood's Chemico Spiral Packing Rings have been selected by so many engineers. The center hole prevents choking and clogging.

Made of acid-resisting shale—practically indestructible.

Used by all big producers because of the intensive movements.

Samples on request.

B. MIFFLIN HOOD BRICK CO., Atlanta, Ga.

N. P. A. History Unfolded For Anniversary Meeting

(Continued from page 60)

tions for installation of new equipment for increased efficiency. The total cost would be $548,436. The estimated annual saving by use of the new equipment would be $320,624. This added to the estimated saving by proper firing results in a total annual estimated saving of $475,564. The engineers state that they have been conservative in their estimates and express the belief that 'any one of these companies has the right to expect even better results.'

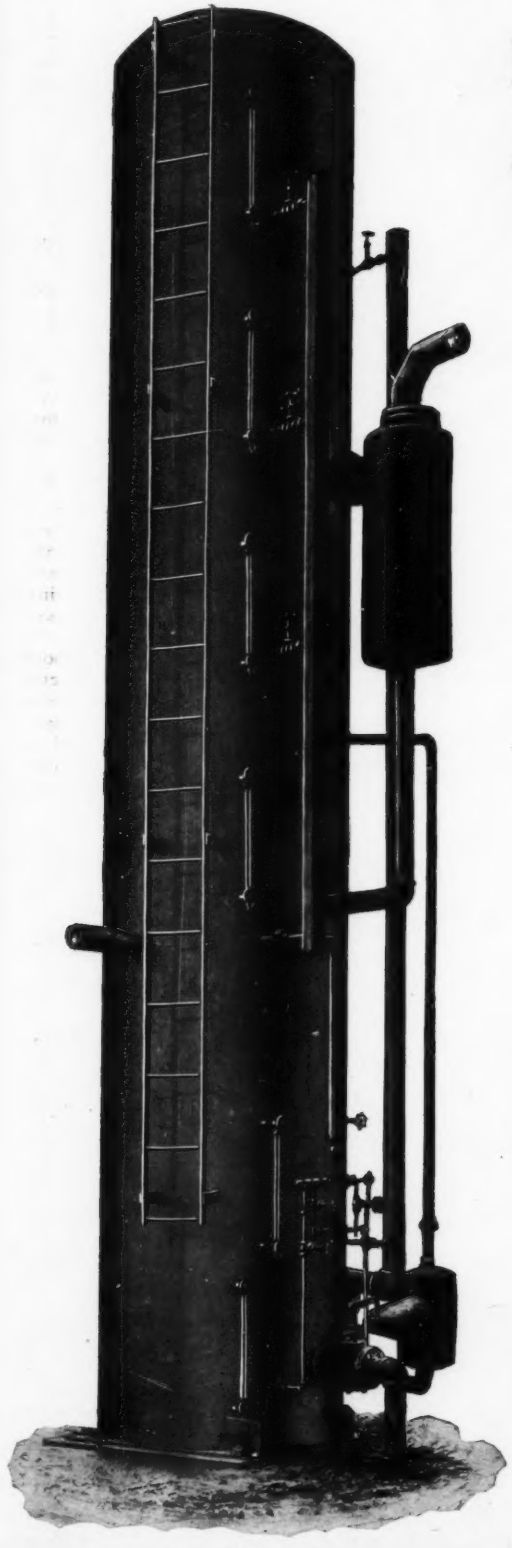
"For 14 of the companies which are participating this year the engineers estimate an aggregate saving, during 1926 and the first seven months of 1927, amounting to $173,930. This estimate they regard as an understatement of the savings for the entire 19 months since some of the companies did not participate in the work during the full year 1926 and as to 1927, some of the figures are still incomplete.

"In comparison with these economies, actual and potential, it may be stated that the annual cost to each member company of securing these co-operative engineering services has been $550. Those executives who have most successfully carried out the indicated economies are enthusiastic about the continuation of work of this character by the association. Others, whose plants have reached satisfactory efficiency, have participated in it out of recognition of its value as a check-up on their normal steam operations. Certainly this activity of the department has served to awaken an interest in general manufacturing efficiency which is in itself a complete justification. There is no thought of carrying co-operative effort in manufacture to the point where it might mean sacrifice of the individual's right to superiority or survival in competition.

Fire Marshal s Association

"The appalling loss of property in the oil industry by fire has centered the activities of this department chiefly in the work of fire prevention. About two years ago a Fire Marshal's Association was organized. Its membership consists of fire marshals who are appointed by the executives of the members participating in this work. The function of the fire marshal is to inspect the property at frequent periods to the end that matters of fire prevention may receive the attention justified by their importance and that fire protection may be kept up to the best standards. Practically all of our members have appointed fire marshals. The group system is followed as in the case of other departments. All of the fire marshals representing the refineries at Warren, for example, were organized into a group. They inspect one of the refineries at that center on each Saturday afternoon. During the inspection each fire marshal notes and records in a memorandum each fire hazard that he observes and thinks should be corrected. After the inspection they meet, discuss the hazards which they have observed and the results of their discus-

THE PROFIT PROCESS



EVAPORATOR

NEWTON Gasoline Absorption Plants

possess the following features: [1] *Simplicity of Operation* [2] *Ease and Rapidity of Erection* [3] *Low Initial Cost of Installation* [4] *Low Maintenance Cost* [5] *Portability* [6] *High Salvage Value* [7] *High Efficiency.*

A DISTINCTIVE feature of Newton plants is the distillation unit which utilizes the high efficiency of the absorber. The distillation unit denudes the oil to the point required for maximum extraction and converts the lower boiling fractions into a marketable product.

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sion are consolidated into a memorandum, a copy of which is given to one of the executives in charge of the refinery. These inspections are thoroughly made and they have brought about the elimination at small expense of numerous fire hazards of which the executives of the several refineries had not been aware. The executives are a unit in expressing their approval of co-operative work of this character. In addition, the fire fighting apparatus and personnel of the several refineries in the district have been co-ordinated so that they are all immediately available to any refinery at which a fire may start. Recently at Warren a fire was started by lightning and in a few minutes all of the fire brigades of the district were at the scene with much of their apparatus. No one question but that the possibility of loss by fire has been greatly reduced as a result of these co-operative efforts.

"The extension of similar activities to groups in other districts is in progress.

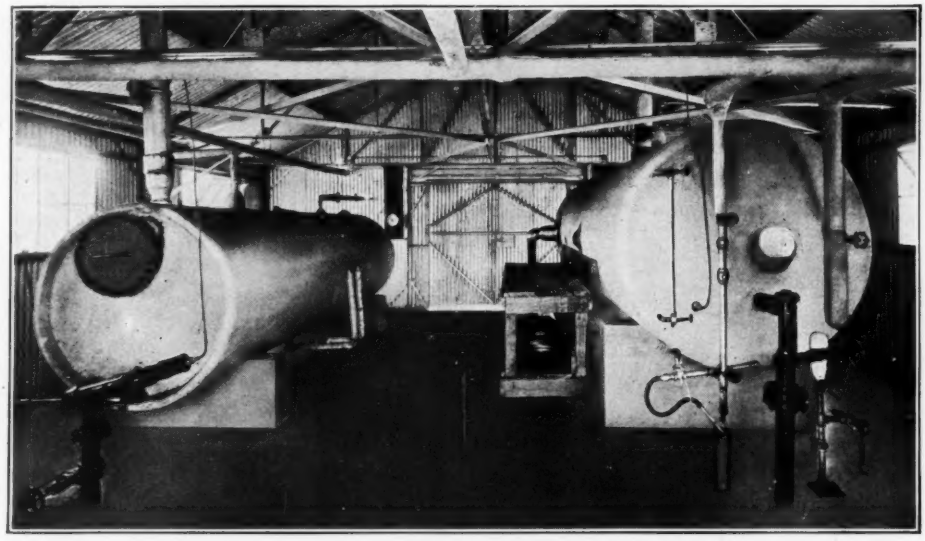
"The creation of a Fire Marshal's Association was not intended as a duplication of organization machinery, nor has it so resulted. Its activities are under the direction of the trustees of the National Petroleum Association. It has a president, who, under the supervision of the trustee in charge of the department, takes the responsibility for the promotion of action by the various groups. A meeting for all fire marshals is held on one day each year, usually in January, at a convenient center such as Pittsburgh. At this meeting the marshals are addressed by one or more men who are trained specialists in the field of fire prevention. After these addresses there is an exchange of information and experiences. The Fire Marshal's Association is an organization without dues, involving little expense, which serves to bring together, identify and advance the interest and knowledge of men upon whom their employers have placed the responsibility of the safety of their plants from damage or destruction by fire.

"The progress of at least one of the fire marshals' groups has advanced to the point where it is ready to undertake also the work of accident prevention. Preparations for this development are being made. The subject of welfare is a broad one and other activities will be suggested for the groups of this department as soon as progress on work already undertaken warrants."

In his closing chapter of the history of the association, Mr. Dow records the following interesting remarks:

"What has been written in the foregoing paragraphs, we venture to hope, will give the reader an impression of the life and character of the National Petroleum Association during the 25 years since its organization in 1902. Hardly more than an impression, perhaps for any detailed account of what it has attempted, successfully or unsuccessfully, to accomplish would involve the statement of issues that are often technical and in part, controversial.

"An association, composed though it may be, of member companies, is after all



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HOTEL HOMES OF PROVEN MERIT

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Every room with bath or shower.

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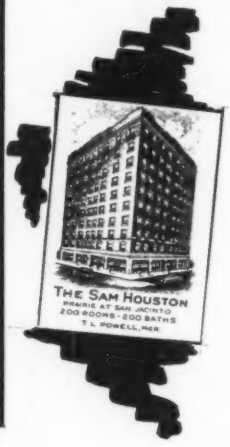
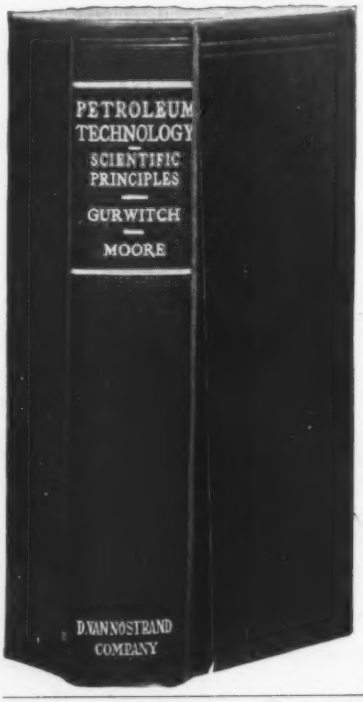


Operation

O'LEARY, MICKELSON & HALL



The Scientific Principles of PETROLEUM TECHNOLOGY

By DR. LEO GURWITSCH

Translated and Revised

By HAROLD MOORE

M. Sc. Tech., M. I. Petrol. Tech., F. C. S., A. I. Mech. E., Consulting Petroleum Technologist.

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This book has stood in the forefront of petroleum literature since its publication in 1912, and up to now could be obtained only in the German.

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a relationship of men. Much as it has done that was of value to its members, there has been no finer achievement of the National Petroleum Association than its friendships. These men came together with not a little distrust of one another. George Brockway tells a characteristic story:

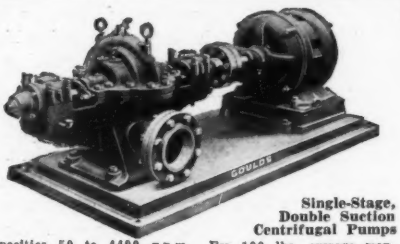
"'I mentioned to the president of our company that I expected to attend the first meeting of the National Petroleum Association in Atlantic City. He said: 'That's fine. Learn all you can, but don't join.' Soon after returning I told him that I had had a good time, had joined the association and had pledged the Seneca for $500 a year. Naturally he was surprised and asked me if I did not remember his telling me not to join. 'Certainly,' I said, 'I remember it.' 'Well,' he replied, 'you must have had good reasons for doing something I told you not to do.' I replied that I did not know whether my reasons were good or not, but this was what had happened. Just after the first session closed two old time refiners met near me. One said to the other, 'Say, do you know I have just met Jack * * (referring to another old refiner), and really he doesn't wear horns.' The other said, 'Yes, I have found that out and I have also found out that Bill * * * doesn't have a forked tail.' I sat there thinking about that conversation and the thought came to me that if at this meeting four refiners, who had been acquainted for years, had really gotten to know each other for the first time, the association was on the right track and we belonged in it. So I walked up to the desk and joined.'

"Mr. Brockway has often told that story and in writing it for this volume he adds, 'That was a good many years ago and how glorious it has been—our knowing each other and working together. Long live the N. P. A.'"

New Refining Company Operating in Canada

Chatham, Ont.—The Regal Oil & Refining Company, Ltd., of Calgary, and its distributing subsidiary, Regal Distributors, Ltd., has completed construction of its facilities and has recently entered the transportation, manufacturing and marketing business in this territory. The company is constructing a pipe line from the Turner Valley field to the nearest rail point at Okotoks, for transporting the Turner Valley production. The refinery, with an initial capacity of 750 barrels daily has been placed in operation, and the Regal Distributors, Ltd., is marketing the products of the plant through a chain of service stations in the immediate territory.

Officers of the Regal Oil & Refining Company, Ltd., are A. G. Spooner, President; F. J. Huff, vice-president and general manager; Charles J. Seifert, treasurer, and Eric Harvey, secretary.



Single-Stage, Double Suction Centrifugal Pumps

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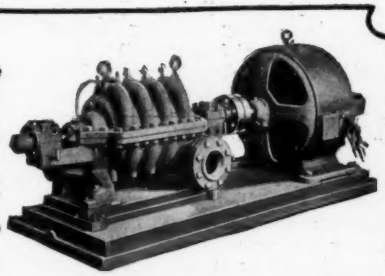

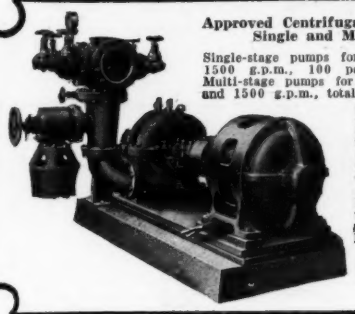

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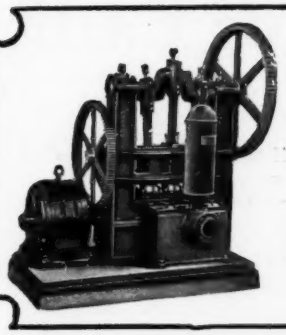

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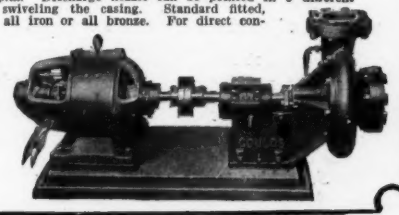

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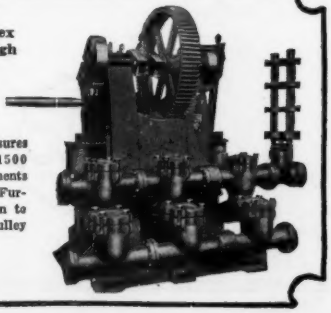

Control of Equilibrium Important Phase in Snelling Cracking Process

(Continued from page 62)

cracking, mention should be made of the general rule, also applicable in the art of cracking, that any chemical reaction doubles its velocity or rate for every 18 degrees F. rise in temperature.

Equilibrium

Another well-known factor in the cracking art, even prior to the issuance of Snelling's present patent, is the fact that the extent to which any given oil can be cracked depends not only on the chemical structure of the hydrocarbons of which that oil is composed, but also on *a relationship existing between the cracked products and the hydrocarbons from which they are formed. This relationship is called EQUILIBRIUM.* And it is the process and means for obtaining and maintaining this equilibrium in cracking that Snelling seems to have covered in his issued patent.

Equilibrium is influenced by conditions such as temperature, pressure and the presence of substances that accelerate the rate of cracking: in other words, by the presence in the oil of catalysts.

The theory of equilibrium in cracking can be explained in simple words by stating that, under specified conditions, the hydrocarbons composing the oil undergoing treatment will crack until a definite amount of cracked products have been formed. Thereafter, if the cracked products are not removed as fast as they are formed, these cracked products will accumulate to a definite amount demanded by the equilibrium, after which substantial cracking of the oil will cease. This behavior and relationship is analogous to the conditions existing during the vaporization of liquids: a definite maximum amount of vapor is able to exist in contact with a liquid and, hence, a point of equilibrium is reached.

The next point to be considered is the effect of temperature and pressure on the cracking equilibrium and the amount of cracked products that can be formed before a condition of equilibrium is reached.

In the ordinary atmospheric distillation of an oil (batch process), only about 1 per cent of the oil is cracked; but if that same oil be distilled, batch, at a high temperature (under pressure), the amount of cracked products would probably be increased at least to about 40 or 45 per cent. It is therefore self-evident that temperature has a very great effect on cracking and on the yield of lighter products obtained from the cracking of any particular oil.

Effect of Pressure

Pressure, on the other hand, has almost an opposite influence on the cracking equilibrium, for the effect of pressure is to retard the cracking reaction. During the cracking of a hydrocarbon oil the individual large particles or molecules decompose into two or more smaller particles, which reaction is naturally suggestive of an increase in volume. Since the effect of pressure is to decrease *volume,* it is readily seen that an increase in pressure will counteract to some extent the cracking tendency.

Although, in view of the above statements, the use of pressure in cracking appears to be unnecessary, this is not the case: but instead pressure and heat are both required in the operation of all commercially-successful cracking processes. When heat alone is used, a hydrocarbon can be cracked into very small particles (molecules) which form permanent gases and free carbon. The latter reaction takes place and is highly desirable in the manufacture of illuminating gas, but it is an undesirable procedure and is not followed whenever finished products, liquid in their characteristics, are desired. The use of pressure prevents, to a considerable extent, the complete cracking of hydrocarbon oils into gases and coke. For that reason, commercial cracking processes making gasoline from heavy oils, such as the Dubbs, Cross, Holmes-Manley, Jenkins, Tube-and-Tank, and other processes, have been economically successful because of a proper balance between the temperatures and pressures used; in all these processes relatively high temperatures are used in order to speed up the cracking operation, while at the same time relatively high pressures also are necessary in order to prevent the complete gasification of the oil being cracked.

Snelling's invention covers the use of equilibrium-accelerating catalysts, such as colloidal nickel, carbon and graphite, and for that reason a few words concerning

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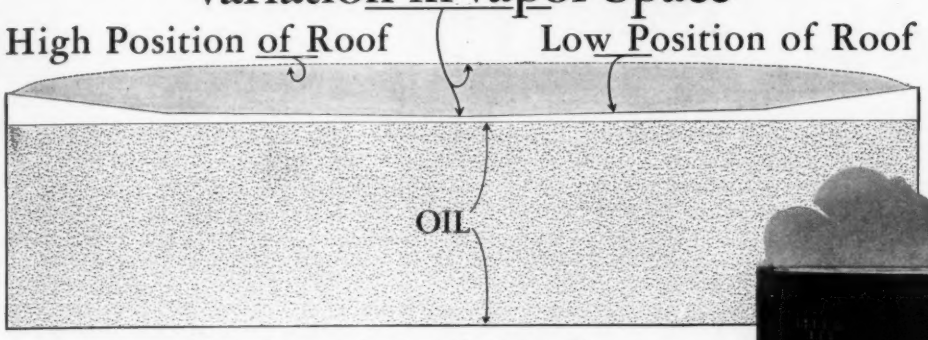
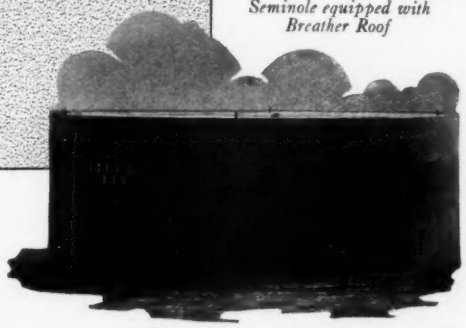


Above: Vapor space is exaggerated to show operating principle clearly on this small sketch

Below: 80,000-barrel tank at Seminole equipped with Breather Roof



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the general subject of catalysts should be of interest.

Action of Catalyst

A catalyst is any substance by the use of which a chemical reaction will proceed with greater rapidity. Such a substance never actually takes part in a reaction, for it is not used up, but merely tends to accelerate the chemical change. The action of a catalyst is aptly described by the statement that the use of a catalyst in a chemical reaction is similar to the use of a lubricant on a machine—it helps to overcome the resistance of the reaction.

Parenthetically, it might be mentioned that catalysts are often very sensitive to certain other substances which destroy their catalystic properties. When a catalyst is thus attacked by another substance it is said to be poisoned. This is very important, since it is the cause of its being impossible to operate some otherwise excellent processes. Sulphur, which is found in most crude oils, has this property of poisoning certain catalysts. In general, a relatively small amount of a catalyst (unless it is poisoned by some other substance) will influence a very large amount of reacting material.

In using catalysts in the cracking of petroleum hydrocarbons the catalyst, in most cases is placed in the body of the oil while it is being cracked; or the oil vapors may be passed through the catalyst or be superheated in its presence. Sometimes the catalyst used is itself in the vapor form.

In connection with the use of a catalyst as mentioned in Snelling's invention, the important thing is to remember that a catalyst does not change the nature of a chemical reaction, *nor does it alter equilibrium relations,* but merely speeds up the reaction.

With the foregoing explanation of some of the various factors involved in cracking, we can now go on to a more detailed discussion and description of Snelling's invention.

In the specifications of his patent Snelling discusses some of the various points in cracking, in substance, as follows:

In the operation of the various cracking processes the oil to be cracked is sometimes maintained in a still; sometimes it is run through a hot tube; while many other variations of the high temperature idea are known. In all processes, however, the practice followed is more or less a distilling operation, the effort ordinarily being made to withdraw the low boiling-point products of unsaturated characteristics from the zone of high heat as fast as they are formed. In a cracking still operating at the ordinary pressures the gasoline formed can remain in the liquid undergoing cracking only momentarily, after which it is evaporated and removed away substantially as fast as it is formed therein, while such as is formed in the vapors is withdrawn with the vapors. Under ordinary operating conditions (Snelling is referring to the cracking art as known in 1915, his filing date) there is no opportunity for the gasoline formed

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to enter into equilibrium reactions either with the liquid or with the vapors.

Purpose of Process

The purpose of Snelling's invention seems to be largely to produce a maximum yield of hydrocarbons of a saturated nature from a heavy oil; for, he says:

"Commercial unsaturated gasoline produced by so heating gas oil or oil residues, with or without pressure, forms what is known as cracked gasoline: . . . I attribute the formation of unsaturated products . . .to the fact that the first products of the breaking-down of oil are largely ethylenic groups and in the ordinary operation the products are withdrawn from the zone of heat so rapidly that not sufficient time is afforded for further rearrangement with saturation.

"I have found that the action of heat and pressure upon oils does not, as is usually presumed, go only one way; it does not merely result in the formation of breaking-down products. On the contrary, I have found that under proper conditions an equilibrium appears in which breaking-down and reconstruction actions go forward until a certain balance obtains between the concentration or amount of the gases, of the low-boiling oils, and of the high-boiling oils in the space afforded for action. Being a true equilibrium it can be approached from either side; that is, I can heat a heavy oil under proper definite conditions until equilibrium is obtained and produce gases, together with what I may call synthetic crude oil; . . . . A definite amount of gas is also produced. On the other hand, I can produce this same equilibrium and make the same types of synthetic crude oil by approach from the other side; that is, by heating light oils, or even hydrocarbon gases, under suitable heavy pressure and at a high temperature. I have, for example, so converted propane and other permanent gases into equilibrium mixtures containing high-boiling hydrocarbons, some of these hydrocarbons boiling as high as lubricating oil. Kerosene and gasoline may be converted into oily mixtures containing lubricating oil, with production of a certain proportion of gases.

"As stated, I regard this operation as resulting in the production of a true equilibrium; . . . . Being a true equilibrium, if one of the products of equilibrium is removed, such a product tends to reform at the expense of the other bodies which, together, are in equilibrium. That is, if I treat crude oil or gas oil or any heavy oil under proper conditions of volume and expansion or vapor space, temperature and pressure, an equilibrium is produced in which there will be, with one ratio of expansion chamber to liquid material, quite constantly about 16 per cent of gasoline. But if during this heating and equilibrium-making operation, I have continuous removal of a relatively small amount of gasoline, more gasoline is formed. The gasoline made under aquilibrium conditions I find to be saturated and good, being wholly unlike the 'cracked gasolines'. Its removal tends to disturb the equilibrium and more and more gasoline tends to form as it is removed."

Ratio of Equilibrium

Snelling further goes on to state that the equilibrium obtained when a high-boiling oil is heated in a closed container without permitting the escape of the products of the reaction depends upon the ratio between the volume of the original liquid and the capacity of the container. He says:

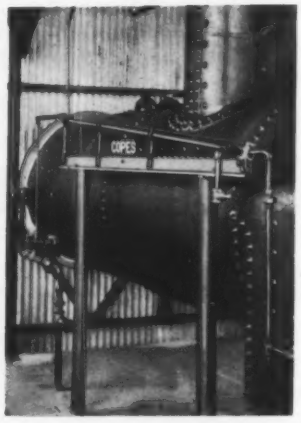
"Whatever the ratio between the volume of oil and what may be termed the expansion space (the space not occupied by the cold oil), there will always be obtained a material like crude oil. But the character of this oil, the equilibirum which obtains in it, will depend very largely upon this ratio. . . . . *The best ratio for the production of gasoline from heavy oil . . . . . is to have an expansion space between five times and two times the volume of heavy oil treated.*"

Concerning the reasons for the existence of these relations between volume of oil and expansion space, Snelling says that he is not certain and contents himself with noting observed results. However, in the specifications, he *does* express an opinion as to the reason for these relations existing as they do.

Operating Process

In discussing the operation of his process, Snelling states:

"Where . . . . . the operation is more or less continuous the products of reaction remain in the reaction chamber in large part, the volume ratios are not so fixed in their nature since, after an equilibrium has been established, differences



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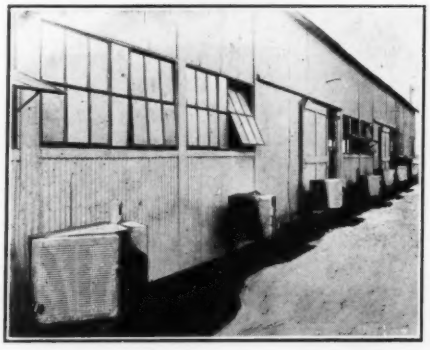

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in the amount of feed and of withdrawal do not alter conditions greatly. That is, if a body of cold oil be placed in a chamber and heated up to equilibrium pressure of 800 pounds, certain ratios between chamber capacity and oil volume must obtain to produce certain results. But, if the chamber be full of hot, compressed gases, vapors and liquids from a preceding operation, then a minor withdrawal of liquid products or addition of new oil does not greatly change the conditions within the chamber; that is, the body of oil maintained under heat is, so to speak, a 'dominant pool', its mass being relatively so great that a minor addition and a minor abstraction do not materially affect the equilibrium conditions within the chamber. For example, if a gallon of heavy oil be placed in a 100-gallon chamber, and heated up gradually, the volatile products of reaction (light oils and gases) would escape into the chamber leaving the oil nearly free of the same, and before the 600 or 800-pounds pressure has been established, the oil will have cracked-down or even coked. But if the chamber be full of gases and vapors under high pressure and temperature, the volume of oil introduced into it becomes less important. Under these conditions, the volatile equilibrium products do not escape from the oil to such an extent. Nevertheless, in the present process, I prefer to *maintain the volume of oil around 3/11ths of the volume of the treatment chamber, although, as stated, rather wide variations are permissible once the equilibrium conditions are established.*"

Snelling claims to have found in operating his process that he could obtain low-boiling oils from heavy oils with very much more economy if he restricted the escape of permanent gases to the lowest possible amount. However, he has also found that some escape of permanent gasses from the system is advantageous, giving as a possible reason the fact that some methane and hydrogen are always produced, which gases are but little reactive: they tend to go into the equilibrium more sluggishly than the other products of the equilibrium-forming reaction. Methane and hydrogen, however, Snelling claims, do have some tendency to take part in the equilibrium and their presence is important as aiding in preventing the formation of more methane and hydrogen, exercising, so to speak, a restraining influence. Although an excess of either will disappear in time, it does so slowly and neither methane nor hydrogen (or both) exercises the active influence in equilibrium that the other products of reaction do.

The remainder of the specifications of Snelling's Patent No. 1,624,848 is devoted to a discussion of the process and apparatus used in obtaining equilibrium conditions in cracking and in otherwise carrying out the invention. Hence, for such information the interested reader is referred to the patent itself, a copy of which can be obtained from the U. S. Patent Office for ten cents.

Important Claims

Sixteen claims were allowed Snelling on his application for patent. Seven of

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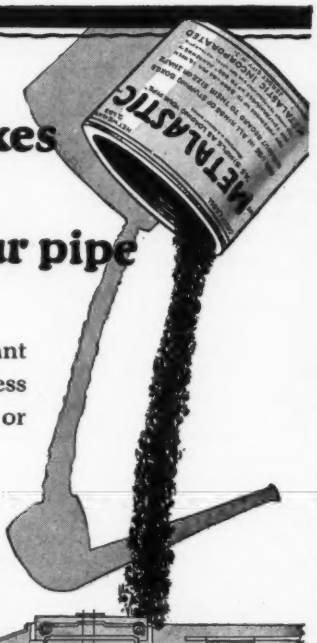

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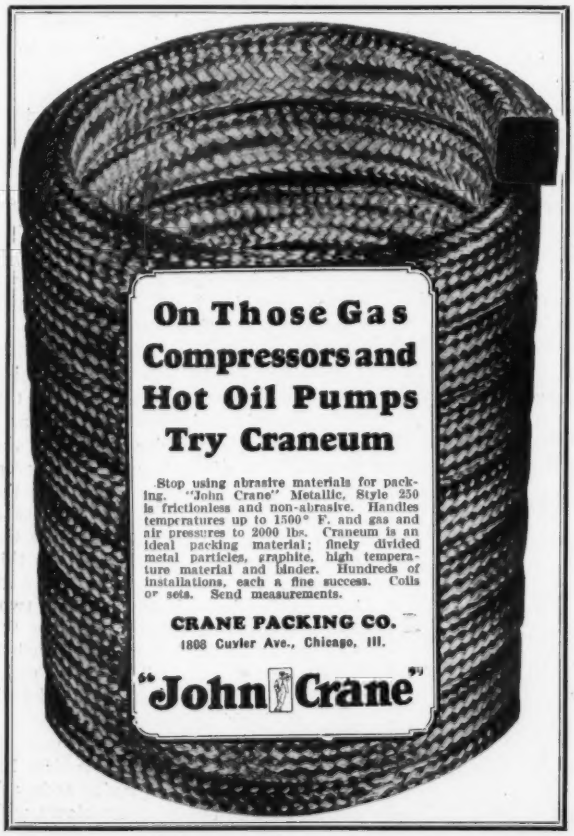
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the most typical of these allowed claims are shown below:

1. The process of converting petroleum oils which comprises establishing and maintaining a body of petroleum oil and vapors therefrom under such heat and pressure as will produce equilibrium in such body and during the maintenance of such equilibrium slowly withdrawing the liquid products of equilibrium and slowly adding fresh oil.

2. The process of converting petroleum oils which comprises establishing and maintaining a body of petroleum oil and vapors therefrom in the presence of a catalyst and under such heat and pressure as will produce equilibrium in such body and during maintenance of such equilibrium slowly withdrawing liquid products of equilibrium and slowly adding fresh oil.

3. The process of converting petroleum oils which comprises establishing and maintaining a body of oil in contact with its own vapors and under such heat and pressure as will produce equilibrium between such vapors and such oil, and during such maintenance slowly withdrawing converted oil from one point in such body and slowly adding fresh oil to another point in such body at a rate insufficient to disturb materially the traveling equilibrium.

6. The process of converting high-boiling petroleum oils which comprises establishing and maintaining a body of such oil in a roomy chamber at a heat and pressure which will produce equilibrium between the oil and its vapors and continuously supplying fresh petroleum material and withdrawing liquid products of equilibrium, such supply and withdrawal being at a rate insufficient to disturb the equilibrium prevailing in such body, the volume of said roomy chamber being less than ten times the volume of oil therein and more than twice as great.

8. The process of producing an equilibrized petroleum oil containing gasoline from a heavy petroleum oil substantially free of gasoline which comprises establishing a relatively shallow layer of oil in a horizontal tubular chamber, heating such oil until a pressure of 600 pounds or higher is attained, maintaining the temperature at this point and during such maintenance slowly withdrawing liquid oil from one end of said chamber and slowly supplying new oil to the other end of said chamber.

12. The process of converting high-boiling petroleum oil which comprises establishing and maintaining a body of such oil in a roomy chamber at a heat and pressure which will produce equilibrium between the oil and its vapors, continuously supplying fresh petroleum material, establishing a plurality of condensing zones, of different predetermined temperatures and withdrawing liquid condensation products from at least one of the said zones, the supply and withdrawal of material being at a rate insufficient to disturb the equilibrium prevailing in such body.

13. The process of converting petroleum materials, which comprises heating a body of the material to a vaporizing temperature in excess of 350 degrees C. while under pressure sufficient to retain at least some of the constituents in liquid state in contact with vapors, then maintaining said liquid and vapors at such temperature and pressure as to maintain an equilibrium of constituent hydrocarbons, and abstracting from the reaction zone portions of products while supplying new material.

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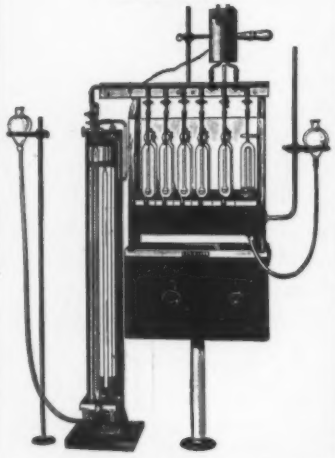

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Recovery of By-Products From Acid Sludge

(Continued from page 64)

recovery of various acid sludges it would be a matter of neglect not to mention those by-products which may be made from sludges formed by acid treating distillates. It has been found that the best final products are obtained when acid sludges from both paraffine and Naphthenic base oil distillates are mixed in various proportions. These proportions have already been determined depending on the physical tests of the products desired.

The process for working up the acid sludge is precisely the same as that discussed in acid sludge recovery from treated reduced crudes. After complete separation of the acid sludge has taken place the acid oil is pumped off the top, the spent acid is drawn from the bottom of the kettle by gravity and that which remains in the kettle is acid coke, or that layer in which we are particularly interested.

The processing of the acid coke layer from now on is quite different from the former method.

Conveying and Treatment of Acid Coke

By the aid of a screw conveyor and water, the acid coke, as it drops from the sludge kettle into a trough by gravity is crushed into a somewhat granular paste and conveyed to a ground tank, where it is pumped into another cooking kettle. When a charge has been pumped into the cooking kettle the contents are allowed to settle approximately 45 minutes, at which time the water is pumped off the top by means of a swing suction. The acid coke, being the heavier, settles to the bottom. It often happens, however, that the water forms in layers with the acid coke, and if such be the case a few minutes air blowing will cause the water to assume one layer. In this condition the water is easily removed. The application of water has a two-fold purpose, namely, to remove the last traces of acid from the crushed coke as much as possible and to make it easier to pump from the ground tank into the cooking kettle.

When all the water has been pumped off and the powdered coke is dry, 100 barrels of 33 degree gravity soda ash are added and the contents blown with

For pipe lines where ordinary valves will not stand up,

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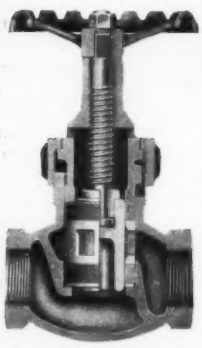

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These valves maintain uniform reduced pressure regardless of fluctuations of initial pressure or flow.

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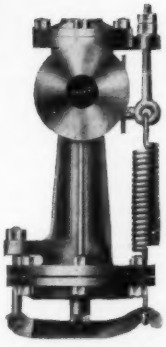

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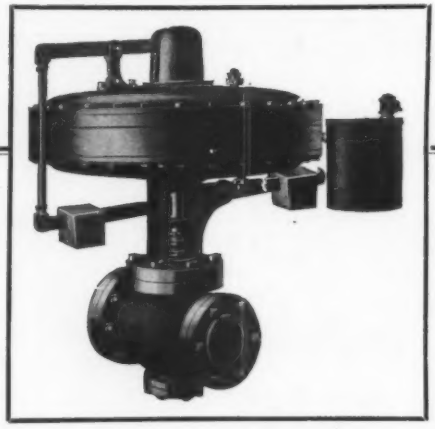

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air for approximately three hours. At this point an average sample is tested for alkalinity. If found to be slightly alkaline, approximately 400 barrels of unfit gas oil (unfit for pressure still charging stock) are added and the contents again blown with air approximately three hours.

After steaming three hours the contents are blown 45 minutes longer, follower by three-four hours steaming. At this point an average sample is taken and tested for alkilinity, using Phenolphthalein as an indicator. As a rule, additional soda ash is required, due to the 500 barrel charge of acid coke. In case it is necessary to add more soda ash it will likewise be necessary to re-steam three hours longer. When a slight excess of soda ash has been added, determined by indicator, 200 barrels of hot water are added and the contents steamed approximately 20 hours. Avoid the addition of a large excess of soda. After cooking for this length of time the treat is finished up with approximately 500-600 barrels of hot water and steamed for one hour. Again the top layer is tested for a slight excess of alkali, using the same indicator as above. If test is satisfactory let settle five hours. At the end of this time draw off spent soda solution from bottom and pump the asphalt stock to a storage tank for further reduction. If asphalt products are not desired, this stock is used as fuel oil.

Oxidized Products

If oxidized asphalt products are desired the following procedure may be carried out:

After the still has been charged it is fired to a temperature of 450 degrees F., at which time top steam is admitted and air added through the bottom steam coils or spider, as the case may be. When the temperature of the still has reached 500 degrees F. the fires are checked and the air allowed to oxidize the asphalt until a temperature of 550 degrees F. has been reached. Samples for melting point determination are taken every half hour and when within 2/5 degrees of the desired melting point, the air is turned off and a slight increase in top steam is made.

When the desired melting point is obtained, everything is cut out of the still and the contents pumped to a storage tank. Asphalt products having melting points ranging from 120-150 degrees F. have been made on a plant scale with marked success, but products having higher melting points have not given very good results. The logical reason for this, no doubt, is due to a too vigorous oxidizing effect upon the by-product.

There are many refineries, now selling these products in the form of fuel oil, that could advantageously convert them into asphalt products and realize a bigger profit. At present the fuel oil problem is by no means a hard one to meet mainly because the fuel oil sup-

OIL METERS *for* CRACKING PROCESSES

The EMPIRE Made to withstand working pressures of 300 pounds to the square inch. Special types can be furnished for higher pressures if required. Standard models for general use will sustain a working pressure of 150 pounds. Sizes range from ⅝ inch to six inches, and are supplied either with clock-like vertical dial, or a horizontally placed straight reading register.

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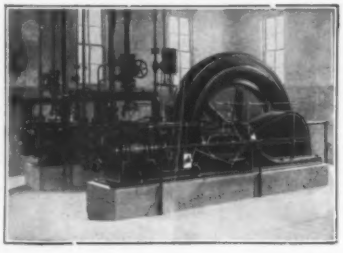

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ply is directly dependent upon the crude oil production. Crude oil production is now in excess of requirements.

The fact that the petroleum industry is beginning to realize the necessity for making those products from crude oil which will bring the largest profit and which will serve a far better purpose than that of burning, is sufficient to cause them to adopt new methods of refining to which they would ultimately have to turn.

The writer believes that he is justified in making the statement that "Never before in the history of petroleum refining has such an opportunity been presented to the refiner whereby he may recover from otherwise so-called valueless by-products, good and 'sellable' lubricants and other products of various kinds."

Cooke Goes to New York With Pan American

Casper, Wyo.—Thomas S. Cooke, formerly of Casper, Wyoming, where he has been manager of the Standard Oil Company of Indiana and Midwest Refining Company's refineries for the past six years, has been appointed manager of the manufacturing department of the Pan-American Petroleum & Transport Company. Pan-American is now controlled by Standard Oil of Indiana.

In his move to the New York office Mr. Cooke takes with him Don C. Cooke, chief engineer in the Rocky Mountain district for Standard of Indiana; Lloyd G. Smith, foreman of the lube oil department at the Casper refineries, and Paul G. Weidner, assistant superintendent of the gas department.

It is reported that the first work of Mr. Cooke and associates in their new positions will be the direction of construction of a large refinery which the Pan American proposed building in Venezuela.

Mr. M. G. Paulus succeeds Mr. Cooke as manager of the refineries at Casper.

Complete Gasoline Plant

Graham, Texas.—The Graham Oil & Gas Company is completing a natural gasoline plant in the Northwest Graham field, Young County, and will handle approximately 10,000,000 cubic feet of gas daily. This plant is made up of part of the equipment formerly used in the H. E. Boner plant, located in the Red River bed section of the Burkburnett field. The gasoline yield is expected to range from two and one-half to three gallons per 1000 cubic feet of gas. Phillip Wiseman and associates of Los Angeles, are the principal owners of the above company, and G. R. Paull is in charge of the operation of the plant, with headquarters in the Staley building, Wichita Falls, Texas.

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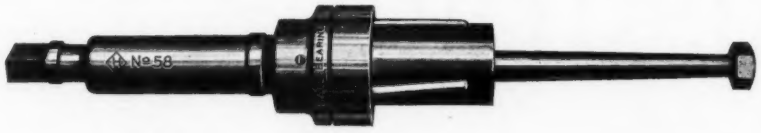

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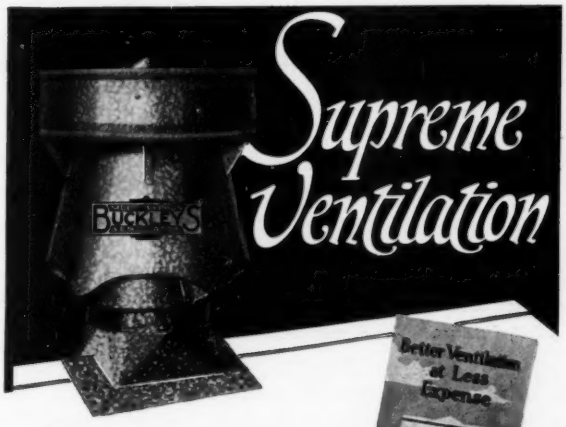

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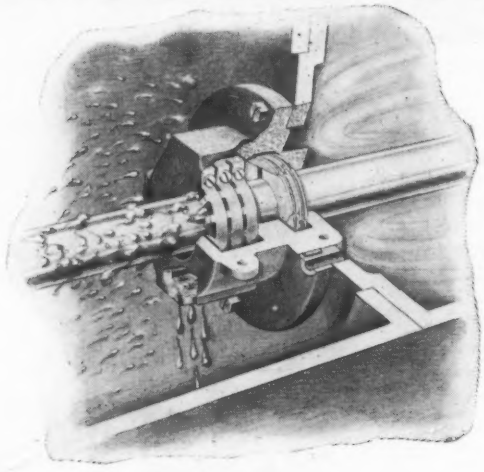

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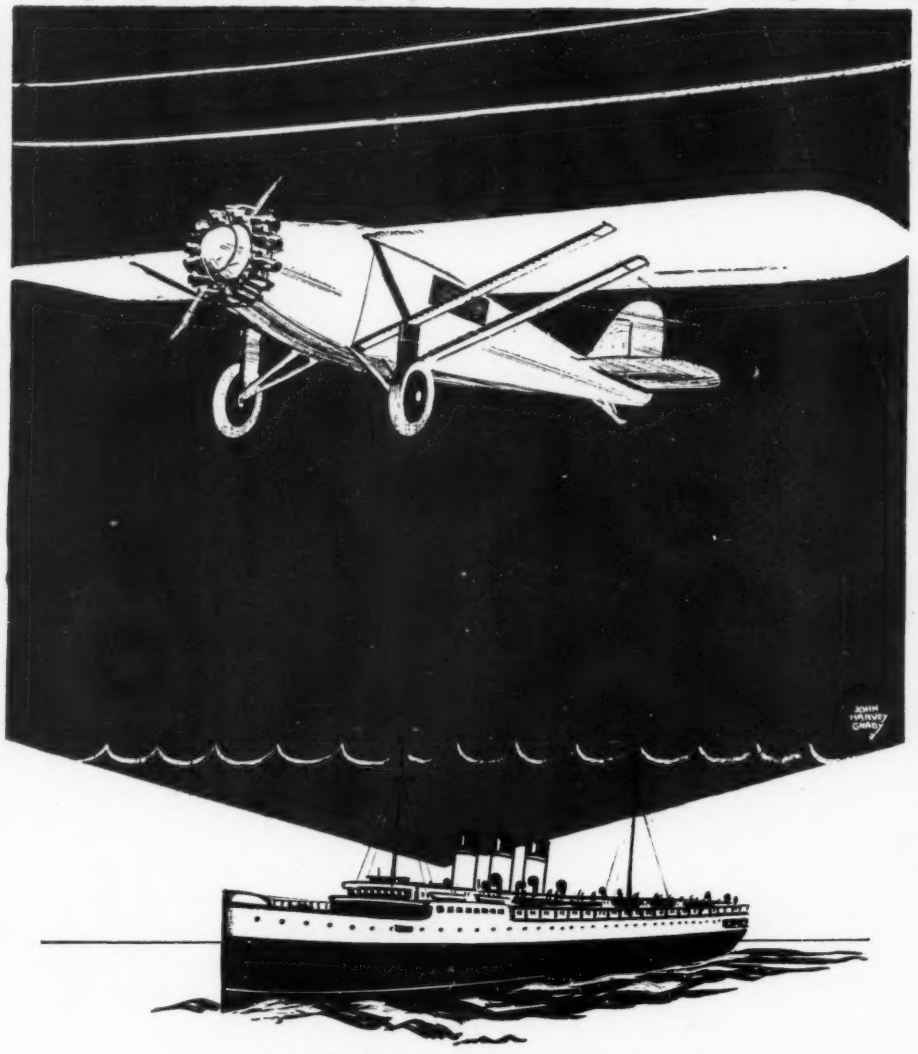

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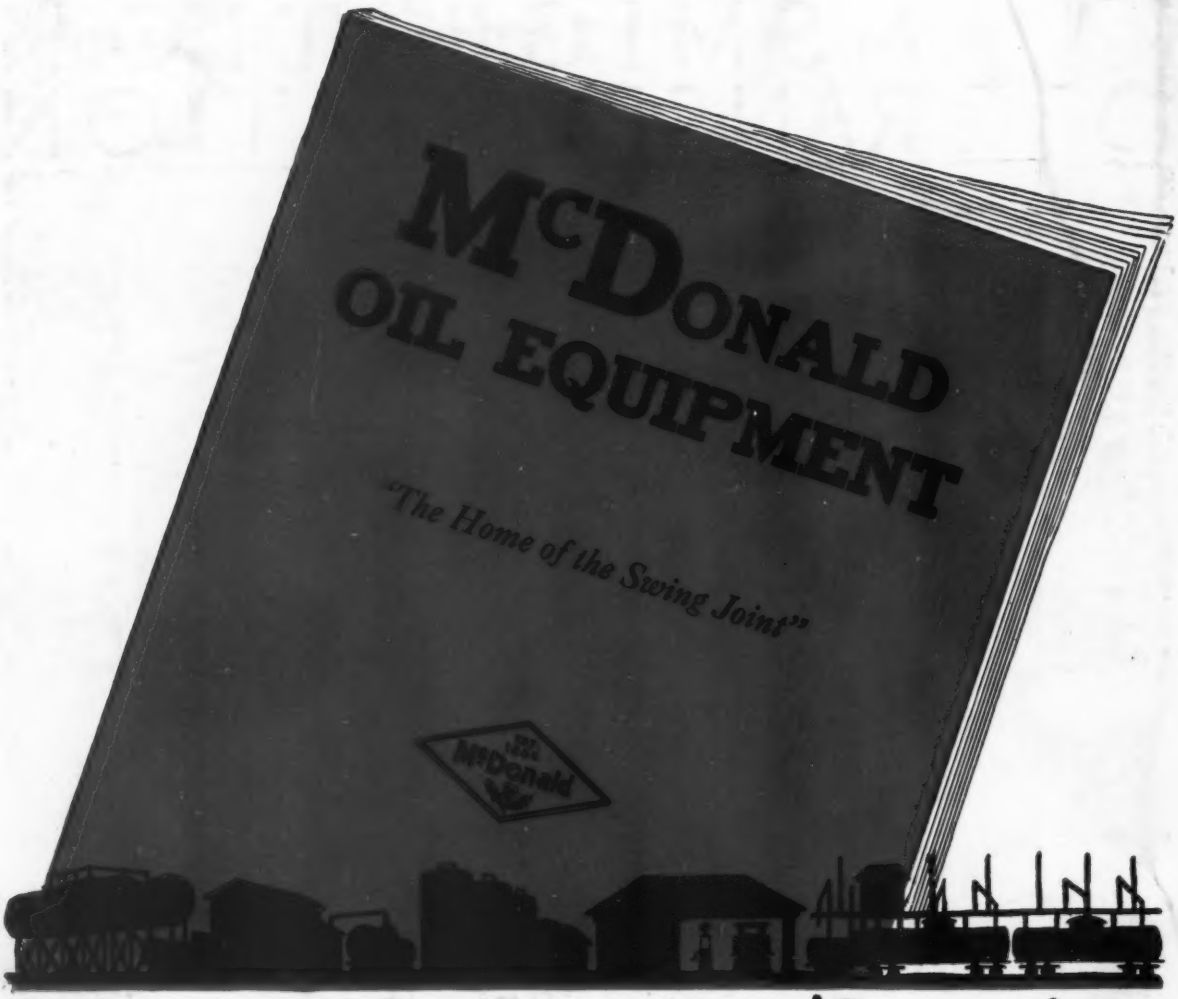

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